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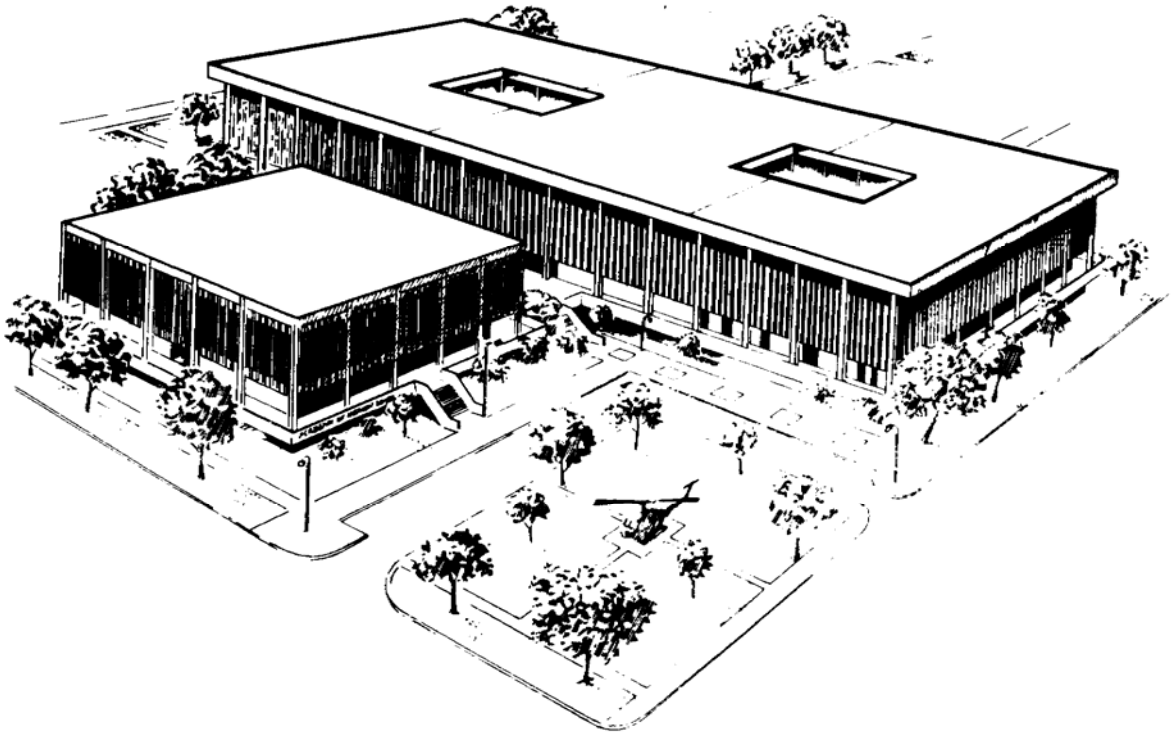

ANESTHESIA APPARATUS

SUBCOURSE MD0353 EDITION 100

DEVELOPMENT

This subcourse is approved for resident and correspondence course instruction. It reflects the current thought of the Academy of Health Sciences and conforms to printed Department of the Army doctrine as closely as currently possible. Development and progress render such doctrine continuously subject to change.

ADMINISTRATION

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CLARIFICATION OF TERMINOLOGY

When used in this publication, words such as "he," "him," "his," and "men" 'are intended to include both the masculine and feminine genders, unless specifically stated otherwise or when obvious in context.

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CORRESPONDENCE COURSE OF
THE U.S. ARMY MEDICAL DEPARTMENT CENTER AND SCHOOL

SUBCOURSE MD0353

ANESTHESIA APPARATUS

INTRODUCTION

For over two thousand years, physicians of many cultures have performed surgery upon anesthetized patients. The anesthetics ranged in type and effectiveness. During certain periods of history, earlier anesthetics were forgotten. In the recent past, a physician relied upon the patient consuming alcohol and biting down hard on anything convenient. Modern general anesthesia began in 1846 when Dr. J.C. Warren first used ether. A dentist named Heidbrink invented the first anesthesia administering machine in 1910. Aside from a few refinements, the machines physicians use today are very similar to the machine invented by Heidbrink. The Ohmeda 885A Anesthesia Apparatus is one such machine.

One of the missions of the Army Medical Department is to provide medical support to the combat soldier under field conditions. Most clinical medical equipment is not rugged enough to survive the field environment, so field medical equipment was designed. The Ohmeda 885A Anesthesia Apparatus is a field anesthesia unit which is rugged, portable, and self-contained. It is your job to keep it operationally efficient. The material in this subcourse covers the preventive maintenance checks and services (PMCS), routine maintenance, calibration and verification, and repair procedures you use to accomplish this task.

Subcourse Components:

This subcourse consists of four lessons as follow:

- Lesson 1, Perform Preventive Maintenance Checks and Services on Anesthesia Apparatus.
- Lesson 2, Perform Calibration/Verification of Anesthesia Apparatus.
- Lesson 3, Isolate Malfunctions to Component Level in Anesthesia Apparatus.
- Lesson 4, Remove and Replace or Repair Defective Components of Anesthesia Apparatus.

Here are some suggestions that may be helpful to you in completing this subcourse:

--Read and study each lesson carefully.

--Complete the subcourse lesson by lesson. After completing each lesson, work the exercises at the end of the lesson, marking your answers in this booklet.

--After completing each set of lesson exercises, compare your answers with those on the solution sheet that follows the exercises. If you have answered an exercise incorrectly, check the reference cited after the answer on the solution sheet to determine why your response was not the correct one.

Credit Awarded:

Upon successful completion of the examination for this subcourse, you will be awarded 5 credit hours.

To receive credit hours, you must be officially enrolled and complete an examination furnished by the Nonresident Instruction Branch at Fort Sam Houston, Texas.

You can enroll by going to the web site http://atrrs.army.mil and enrolling under "Self Development" (School Code 555).

A listing of correspondence courses and subcourses available through the Nonresident Instruction Section is found in Chapter 4 of DA Pamphlet 350-59, Army Correspondence Course Program Catalog. The DA PAM is available at the following website: http://www.usapa.army.mil/pdffiles/p350-59.pdf.

LESSON ASSIGNMENT

LESSON 1	Perform Preventive Maintenance Checks and Services on Anesthesia Apparatus.
TEXT ASSIGNMENT	Paragraphs 1-1 through 1-6.
LESSON OBJECTIVES	After you have completed this lesson, you should be able to:

1-1. Identify the theory of operation of an Ohmeda 885A Anesthesia Apparatus.

1-2. Identify the cautions and warnings concerning PMCS on the anesthesia apparatus.

1-3. Identify the preoperative tests and procedures for the anesthesia apparatus.

1-4. Identify procedures for performing PMCS on the Ohmeda 885A Anesthesia Apparatus.

SUGGESTION Work the lesson exercises at the end of this lesson before beginning the next lesson. These exercises will help you accomplish the lesson objectives.

LESSON 1

PERFORM PREVENTIVE MAINTENANCE CHECKS AND SERVICES ON ANESTHESIA APPARATUS

Section I. OPERATIONS

1-1. GENERAL

The Ohmeda 885A Anesthesia machine is designed for surgery patients that require some degree of anesthetizing. The Ohmeda 885A delivers the anesthetic agent to the patient. The anesthetic, either gases or vapors, mixes with oxygen at precise levels. This is the crucial aspect of anesthesiology. The Model 885 Conversion Anesthesia Apparatus provides all the minimum essentials for administration of anesthesia for adults and children. It accommodates large (M and G size) and small (D and E size) cylinder gas supplies. This lesson starts with the overall theory of operations for the anesthesia apparatus. This provides the basis for a better understanding of the types of preventive maintenance checks and services (PMCS) you must perform.

1-2. THEORY OF OPERATIONS

Refer to figure 1-1, Adult re-breathing circuit, and figure 1-2, Pediatric partial re-breathing circuit, when reading this section. Both these circuits consist of two operational circuits: the delivery circuit and the re-breathing circuit. The delivery circuit is identical for both; however, due to a child's physiology, the re-breathing circuit is different. The delivery circuit uses oxygen (O_2), a life-support gas, and nitrous oxide (N_2O), a temporary general anesthesia. The delivery circuit routes these gases through a series of flow meters, regulators, and valves. This reduces the pressure delivered from the gas cylinders. These monitor the delivery circuit so that the patient's inhalation is not hampered by too much pressure within the system. This is discussed in paragraph "a" below. A pure flow of oxygen picks up additional anesthetic vapors in the vaporizer. It then combines with the oxygen-nitrous oxide flow to achieve the desired ratio of oxygen and anesthetic for the patient. The new mixture flows on to the patient through the closed re-breathing circuit. Both types of re-breathing circuits are discussed in paragraphs b and c below.

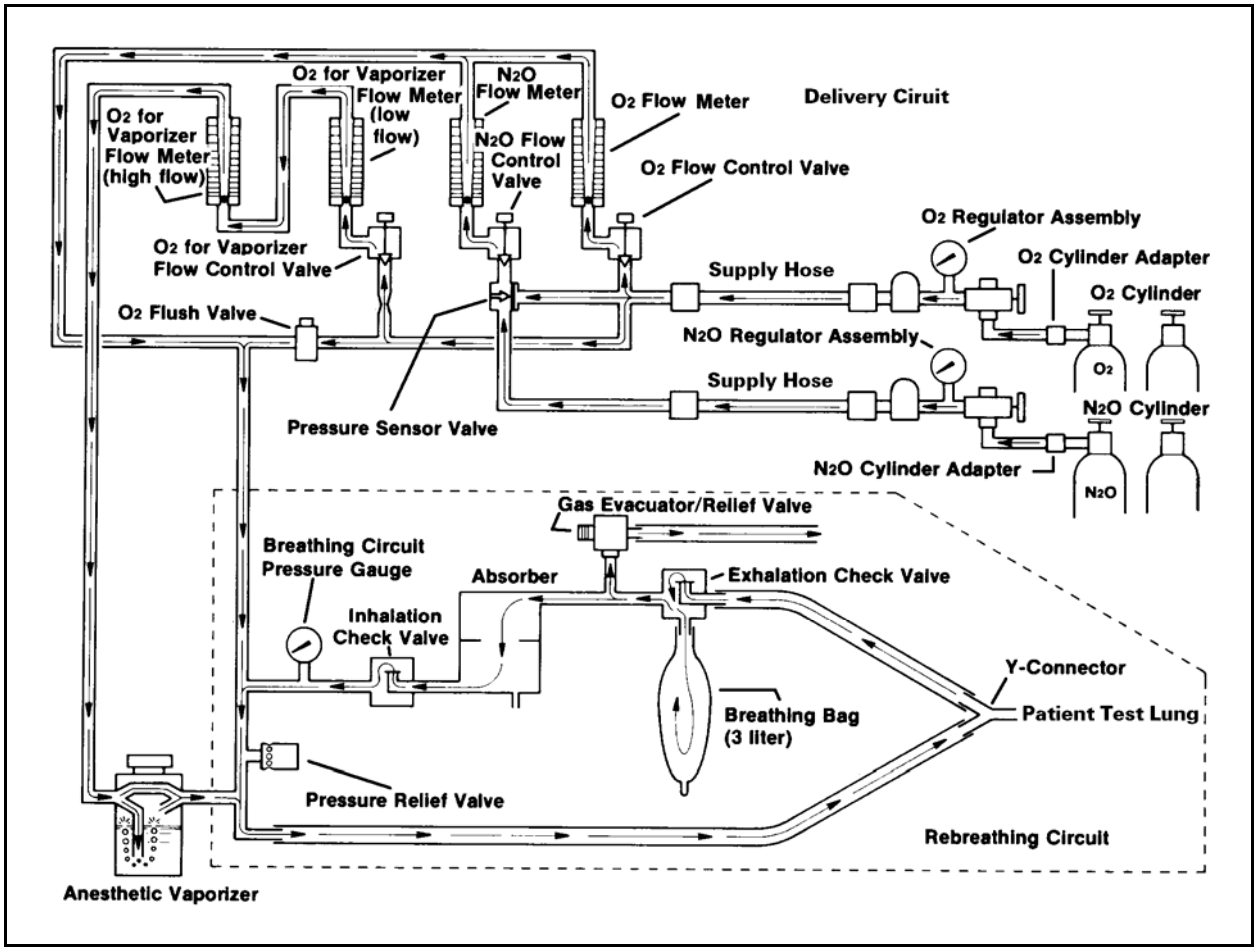


Figure 1-1. Adult re-breathing circuit.

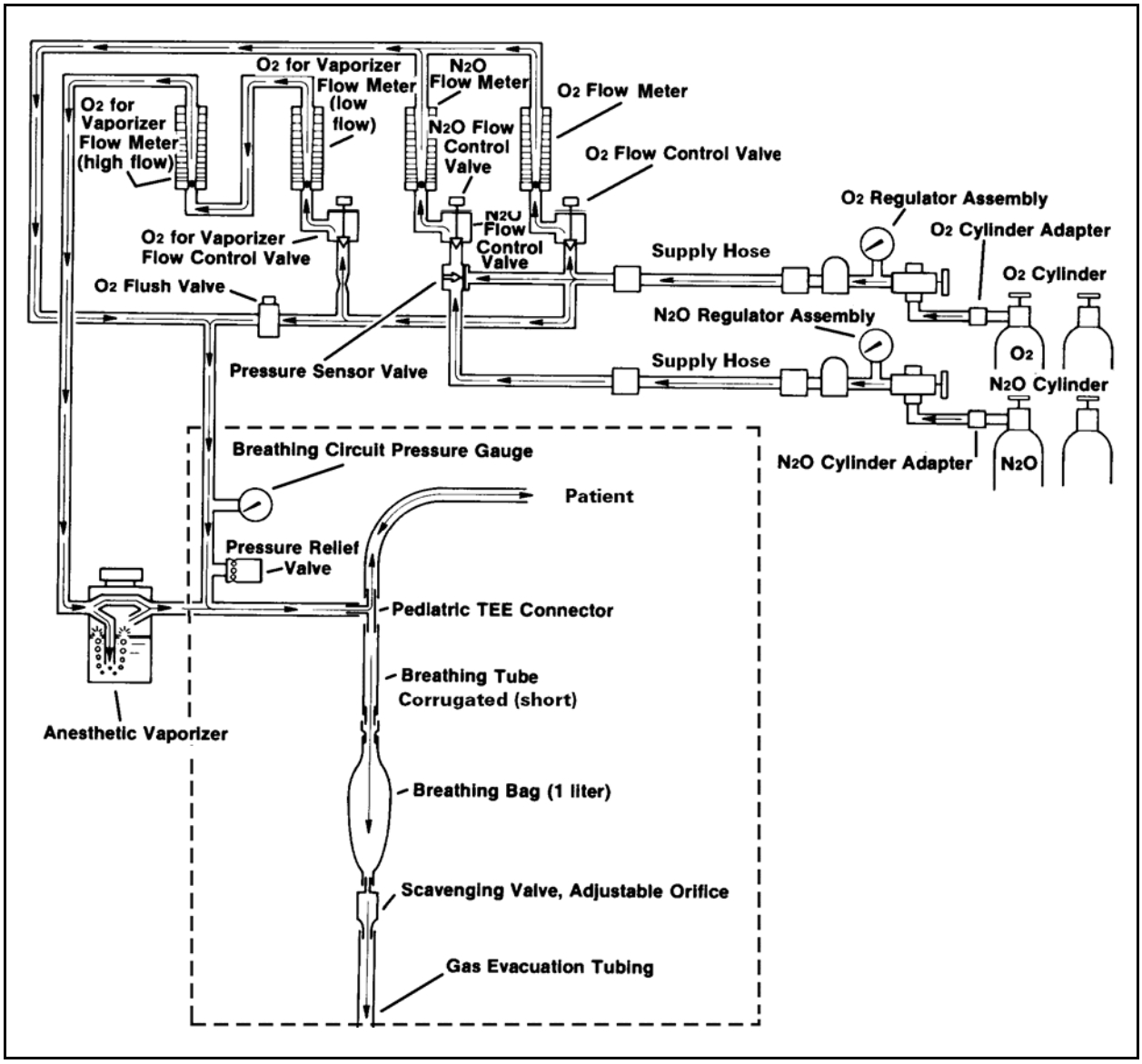


Figure 1-2. Pediatric partial re-breathing circuit.

a. **The Delivery Circuit.**

(1) Components. The delivery circuit consists of the following items and components:

(a) The oxygen and nitrous oxide gas cylinders.

(b) The cylinder regulator assemblies.

(c) The cylinder adapters (if using large cylinders).

(d) The pressure sensor shut-off valve.

(e) The flow control valves and flow meters.

(f) The oxygen flush valve.

(g) The anesthetic vaporizer.

(2) The flow. Refer to figures 1-1 and 1-2.

(a) Oxygen and nitrous oxide cylinders provide the gas supply for the anesthesia apparatus. The output from both cylinder gas supplies leave their respective cylinders at high pressures. They must be regulated to a lower pressure before entering the supply hoses leading to the control head. Regulators within the regulator assemblies reduce the cylinder gas supply pressures to about 40 pounds per square inch as measured on a gauge (psig).

(b) Both oxygen and nitrous oxide flow out of their respective regulator assemblies through the supply hoses into the control head. Oxygen takes three flow paths after it enters the control head; nitrous oxide takes only one path.

(c) Metabolic oxygen flows to the metabolic oxygen flow control valve which, if open, admits the oxygen flow to the metabolic oxygen flow meter. After measurement, the oxygen flows into the common mixing passage in the flow meter top manifold.

(d) Metabolic oxygen also flows through the pressure sensor valve in the nitrous oxide flow path. The pressure sensor valve closes off nitrous oxide if there is an oxygen supply failure or depletion. If the pressure sensor valve and the nitrous oxide flow control valve are open, nitrous oxide flows to the nitrous oxide flow meter. Measured nitrous oxide then flows into the common mixing passage. There it mixes with the metabolic oxygen flow. The oxygen-nitrous oxide mixture flows directly into the breathing circuit. It does not enter the vaporizer at any time.

(e) A line of independent oxygen flows to the "O_2 for vaporizer" flow control valve, flow meter, and the oxygen flush valve. Pure oxygen is necessary to operate the vaporizer. When the flow control valve is open, it admits oxygen to a series-connected high-flow and low-flow flow meters. This oxygen does not flow through the common mixing passage. When the vaporizer control knob is ON, the oxygen flows through the vaporizing chamber. Oxygen serves as a "vehicle" to carry the vapor out of the vaporizing chamber. This vapor-saturated oxygen mixes with the oxygen-nitrous oxide mixture flowing from the common mixing passage. If the vaporizer control knob is OFF, all vehicle oxygen bypasses the vaporizing chamber flowing directly to the vaporizer outlet nipple.

(f) The oxygen-nitrous oxide mixture dilutes the vapor saturated oxygen flow. This results in an amount of anesthetic suitable to the patient. The new mixture flows into the inhalation breathing tube.

b. **The Breathing Circuits: Adult Re-breathing Circuit.** Refer to figure 1-1.

(1) Adult re-breathing circuit components. The adult re-breathing circuit consists of the following items and components:

(a) The breathing circuit pressure gauge.

(b) The nonadjustable pressure relief valve.

(c) The absorber.

(d) The inhalation and exhalation check valves.

(e) The gas evacuation/relief valve.

(f) The large breathing bag.

(g) The breathing tubes and patient connections (Y-connector, elbow, and mask).

(2) Adult re-breathing circuit flow.

(a) The patient's breathing and the inhalation and exhalation check valves control the direction of flow within the breathing circuit. The adjusted total flow of gases from the delivery circuit flows to the patient via the breathing tube. The breathing tube leads from the vaporizer to the patient Y-connector.

(b) When the patient exhales, he directs the gas, via the other breathing tube, to the exhalation check valve. The exhalation check valve opens, the breathing bag expands, and the inhalation check valve closes. When the patient inhales, the exhalation check valve closes, the breathing bag contracts, and the inhalation check valve opens.

(c) Gas flowing through the exhalation valve enters the absorber and flows downward through the soda lime canisters. The soda lime absorbs the carbon dioxide (CO_2) from the exhaled mixture. The remaining gases recycle out of the absorber to the inhalation check valve to rejoin the fresh gas flow. The cycle then begins again.

(d) There are two relief valves within the breathing circuit: the gas evacuator/relief valve and the nonadjustable pressure relief valve. If the gases within the breathing circuit exceed an established pressure, these valves release excess gas to the atmosphere.

c. **The Breathing Circuits: Pediatric Partial Re-breathing Circuit.** Refer to figure 1-2.

(1) Pediatric partial re-breathing circuit components. The pediatric partial re-breathing circuit consists of the following items and components:

(a) The pediatric supply tube with connector and TEE.

(b) The short corrugated breathing tube with connectors.

(c) The small (1 liter) breathing bag with the scavenging valve.

(d) The patient connections (elbow and mask).

(2) Pediatric partial re-breathing circuit flow.

(a) The adjusted total flow of gases from the vaporizer travels through the pediatric supply tube to the TEE connector. The gas takes two directions at the tee connector flowing to the patient and to the small breathing bag.

(b) Gas which the patient has exhaled flows to the small breathing bag along with whatever fresh gas was not inhaled.

(c) Some of the gas which enters the small breathing bag flows through the scavenging valve into the gas evacuation system. The anesthetist may administer gas in the breathing bag to the patient by squeezing the breathing bag. The anesthetist determines the amount of gas allowed to escape through the scavenging valve. He also determines the amount of gas delivered to the patient from the breathing bag. This provides the anesthetist the flexibility needed to anesthetize small infants as well as larger children.

(d) The anesthetist always keeps the gas evacuator/relief valve completely closed when using the pediatric partial re-breathing circuit. To relieve excess pressure as shown on the breathing circuit pressure gauge, the apparatus uses the nonadjustable pressure relief valve.

1-3. PREOPERATIVE TESTS AND PROCEDURES

To ensure the operational efficiency of the Ohmeda Anesthesia Unit before any operation, you must perform a series of preoperative tests and procedures. While not a true PMCS of the anesthesia apparatus, these tests and procedures ensure that the unit is serviceable and can be safely operated.

a. **Operational Checkout.** The operational checkout tests the overall functioning of the apparatus.

(1) Connect the oxygen and nitrous lines to the gas cylinders.

(2) Connect the test lung to the patient connection.

(3) Slowly turn on all three flow meters to ensure they work. Turn on one flow control valve at a time; then shut it off. Leave the N_2O flow control valve on.

(4) To check the pressure sensor valve, unplug the oxygen line from the cylinder. The nitrous ball in the flow meter must drop to zero flow.

(5) Attach the oxygen line to the gas cylinder.

(6) Turn the N_2O flow control valve off.

(7) Press the oxygen flush and observe the pressure gauge. The gauge should rise slowly as you pressurize the system.

(8) Pressurize the system until the gauge shows a pressure of approximately 25 centimeters of water (cm H_2O).

(9) Release the oxygen flush. The system should hold pressure with the vaporizer ON and OFF.

(10) Observe the check valves. One should be up and one down.

(11) Squeeze the test lung (the test lung is included with the tool kit for medical equipment) while observing the check valves. The up and down check valves should reverse themselves.

(12) Depressurize the system using the gas evacuator/ relief valve.

(13) Pull off the inhalation hose from the vaporizer.

(14) Put your hand over the vaporizer outlet and push the oxygen flush. The pressure relief valve should relieve pressure.

b. **Non-adjustable Pressure Relief Valve "Pop-off."** To make sure that the non-adjustable pressure relief valve will operate or "pop-off" if pressure builds up within the breathing circuit, you must perform the following procedure. Make this test before each general setup of the apparatus. Performing this procedure is particularly important if the apparatus has been in storage for a period of time.

(1) Close the cylinder supplies.

(2) Close the flow control valves to their stops.

(3) Close the gas evacuator/relief valve.

(4) Plug the vaporizer outlet nipple and the two exhalation check valve nipples using the protective closure devices.

(5) Open the cylinder oxygen valve.

(6) Open the metabolic oxygen flow control valve to show the maximum flow (7 liters per minute [lpm]).

(7) Verify that the nonadjustable pressure relief valve opens before the gauge needle reaches approximately 80 mm Hg on the breathing circuit pressure gauge.

(8) Close the oxygen flow cylinder valve.

(9) Close the oxygen cylinder valve.

c. **Zeroing the Breathing Circuit Pressure Gauge.** You should check the breathing circuit pressure gauge before each use of the apparatus to make sure the needle rests at zero. If zeroing is necessary, perform the following steps:

(1) Place the apparatus in an upright position.

(2) Adjust the small slotted screw under the edge of the gauge body by turning the screw and observing the gauge dial.

(3) Adjust the gauge until the pointer rests at zero (plus or minus 1 millimeter of mercury [±1 mm Hg]).

d. **Leak Test Procedures.** You must ensure there are no significant gas leakages from the anesthesia apparatus to the atmosphere. To do this you must perform a series of leak test procedures. Perform these procedures before each use of the apparatus.

WARNING

The leakage of gases and vapors to the atmosphere from the anesthesia apparatus circuits may deprive the patient of metered gases and the anesthetic agent. It also may pollute the atmosphere. It could unnecessarily expose the medical staff to the anesthesia. It is important that you perform tests to determine possible leakage before each use of the apparatus. You must reduce the leakage to an acceptable level. Do not use the apparatus if the apparatus circuit does not conform to the stated specifications. No repair should ever be undertaken or attempted by anyone not having training for repairing devices of this nature.

(1) Leak test procedure number 1. Perform Leak Test Procedure Number 1 to determine if there is a significant leak within the circuit from the cylinder valve to the end of the supply hose.

(a) Disconnect the supply hoses from the supply head.

(b) Plug the open end of the supply hose with the protective closure devices.

(c) Open the cylinder valves S-L-O-W-L-Y.

(d) Note the pressure gauge readings on the regulator assembly gauges.

(e) Close the cylinder valves.

(f) Observe the pressure on each gauge.

(g) For gas supplied from small cylinders, verify that the pressure shown on each gauge does not drop more than 100 psig per 5-minute period. If the pressure drops at a faster rate, a significant leak exists at some point within the circuit from the cylinder valve to the disconnected end of the supply hose. If a significant leak exists, isolate and repair the malfunction. (Refer to Lesson 3, Isolate Malfunctions to Component Level in Anesthesia Apparatus, and Lesson 4, Remove and Replace or Repair Defective Components of Anesthesia Apparatus.)

(h) For gas supplied from large cylinders, verify that the pressure shown on each gauge does not drop more than 100 psig per 7-minute period. If the pressure drops at a faster rate, a significant leak exists at some point within the circuit from the cylinder valve to the disconnected end of the supply hose. If a significant leak exists, isolate and repair the malfunction.

(i) Remove the protective closure devices from the supply hoses.

(2) Leak test procedure number 2. Perform Leak Test Procedure Number 2 to determine that the flow meters are functioning properly.

(a) Connect the supply hoses to the regulator assembly outlets and the control head inlets.

(b) Close all three flow control valves to their stops.

(c) Open the cylinder valves to the pressurized circuit.

(d) Close the cylinder valves. No flow should be indicated on the four flow meters.

(e) Verify that the flow meter indicates no flow. If the flow meter indicates a flow, isolate and repair the malfunction.

(3) Leak test procedure number 3A. Perform leak test procedure number 3A on the adult re-breathing circuit to determine that there are no significant leaks in the circuit.

(a) Remove the three-liter bag from the lower exhalation check valve nipple.

(b) Insert a protective closure device in place of the breathing bag on the lower exhalation check valve nipple.

(c) Turn the gas evacuator valve/relief valve knob clockwise to the closed position.

(d) Close all flow control valves to their stops.

(e) S-L-O-W-L-Y open the oxygen cylinder valve until it is completely open.

(f) Open the oxygen flow control valve gradually and establish a 200 cubic centimeters per minute (cc/minute) flow.

(g) Block the Y-connector opening.

(h) Observe the breathing circuit pressure gauge.

(i) Verify that the breathing circuit rises to 35 mm Hg or higher as you pressurize the apparatus circuit. If the pressure does not rise to at least 35 mm Hg, the circuit has a significant leak. If a significant leak exists, isolate and repair the malfunction.

(j) Turn the control knob ON and repeat steps (a) through (i) for the vaporizer control valve in the ON position and then in the OFF position.

(k) When you finish this leak test procedure, remember to close all cylinder valves and flow control valves.

(4) Leak test procedure number 3B. Perform leak test procedure number 3B on the pediatric partial re-breathing circuit to determine that there are no significant leaks in the circuit.

(a) Close the scavenging valve as far as possible.

(b) S-L-O-W-L-Y open the cylinder valve all the way.

(c) Open the oxygen flow control valve gradually and establish a 200 cc/minute flow.

(d) Block the opening in the pediatric TEE connector.

(e) Pinch the small breathing bag nipple above the scavenging valve.

(f) Observe the breathing circuit gauge. Verify the breathing circuit pressure gauge rises to 35 mm Hg or higher as you pressurize the apparatus circuit. If the breathing circuit pressure gauge does not rise accordingly, isolate and repair the malfunction.

(g) Release the breathing bag nipple and adjust the oxygen flow to 500 cc/minute.

(h) Verify that the breathing circuit pressure gauge does not exceed 3 mm Hg. If it exceeds this amount, isolate and repair the malfunction.

(i) Turn the control knob ON and repeat steps "a" through "h" for the vaporizer control valve in the ON position.

(j) With the control knob ON, repeat steps "a" through "h" for the vaporizer control valve in the OFF position.

Section II. PREVENTIVE MAINTENANCE CHECKS AND SERVICES

1-4. GENERAL

You must conduct periodic PMCS of the anesthesia apparatus to ensure the continued operation of the apparatus under field conditions. PMCS procedures are given in paragraphs 1-5 and 1-6.

1-5. PREVENTIVE MAINTENANCE

Preventive maintenance consists of changing the soda lime in the absorber canisters, verifying the check valve is clean, and verifying the gas evacuator/relief valve operates smoothly.

a. **Change Soda Lime in Canisters.** You must change the soda lime in the canisters within 4 hours of use if there is a color change in the lower canister. This color change is from blue to white. Before connecting the absorber to any patient, the anesthetist ensures that the remaining capacity of the soda lime is adequate for the case at hand. The anesthetist judges by the color of the soda lime after the last use. The color fades over time, making later estimates unreliable.

(1) Refill the canister.

(a) Fill the canister with soda lime.

(b) Eliminate dust and fine granules.

(c) Do not over/underfill the canister.

(d) An alternate procedure is to use factory Pre-Pak, pre-filled absorbent cartridges. Ensure you remove the screens from the base of the canisters to prevent resistance in the patient breathing circuit from being too high.

(2) Rotate the canisters to ensure the absorption capacity of the soda lime is more fully used.

(a) Fill the top canister with fresh soda lime.

(b) Replace the lower canister with the top canister.

(c) Replace the top canister with the lower canister.

b. **Check Valve Maintenance.** Periodically, ensure that the check valve is clean. Refer to figure 1-3 to see an exploded view of the control head.

CAUTION: Avoid damaging the seat. Do not pull on the valve disc.

(1) Check for valve cleanliness.

(2) Disassemble the valve if it is not clean.

(a) Unscrew the threaded ring.

(b) Lift off the window and gasket.

(c) Pull the valve cage and the valve disc off the seat.

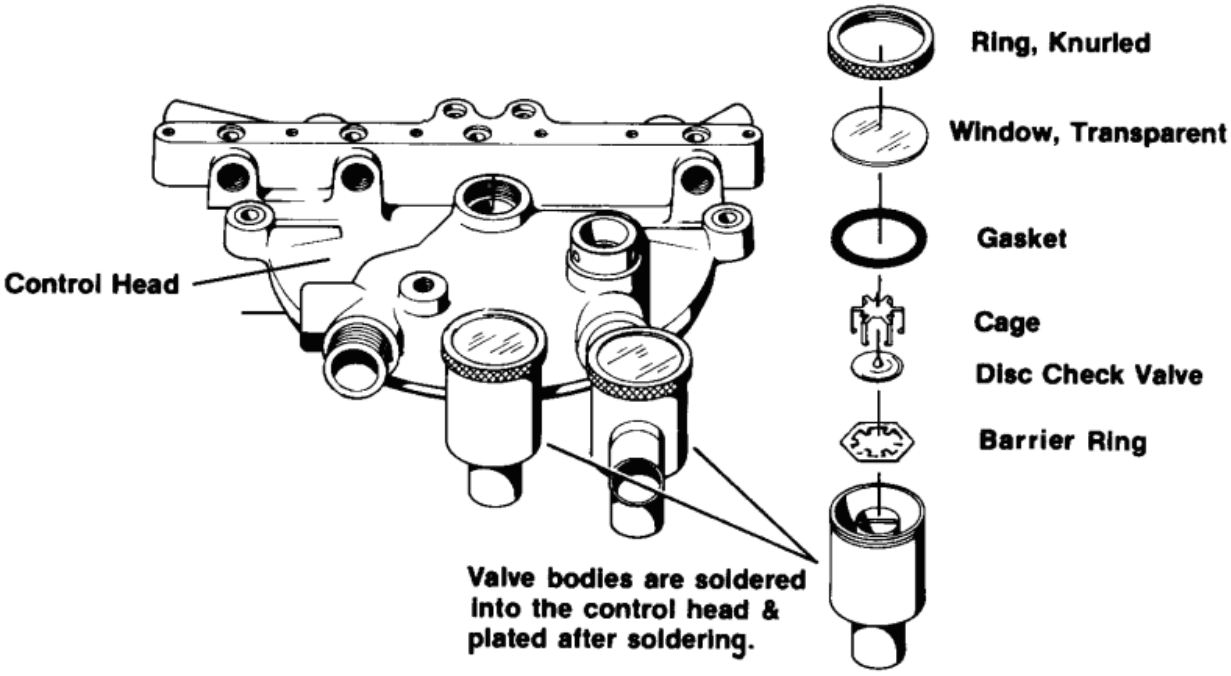


Figure 1-3. Control head-check valve.

(3) Clean loose parts.

(a) Wash in soapy water.

(b) Rinse in clear water.

(c) Dry thoroughly.

(d) Do not use ether on the plastic window.

(e) Clean the seat by wiping the seat to remove foreign matter. Dry it thoroughly.

(4) Replace loose parts.

(a) Clamp the legs of the cage on the shoulder under the seat.

(b) Ensure that the conical projection of disc points up.

c. **Gas Evacuator/Relief Valve Maintenance.** Periodically, check the gas evacuator/relief valve to ensure valve does not stick open or shut and does not shutter. Refer to figure 1-4.

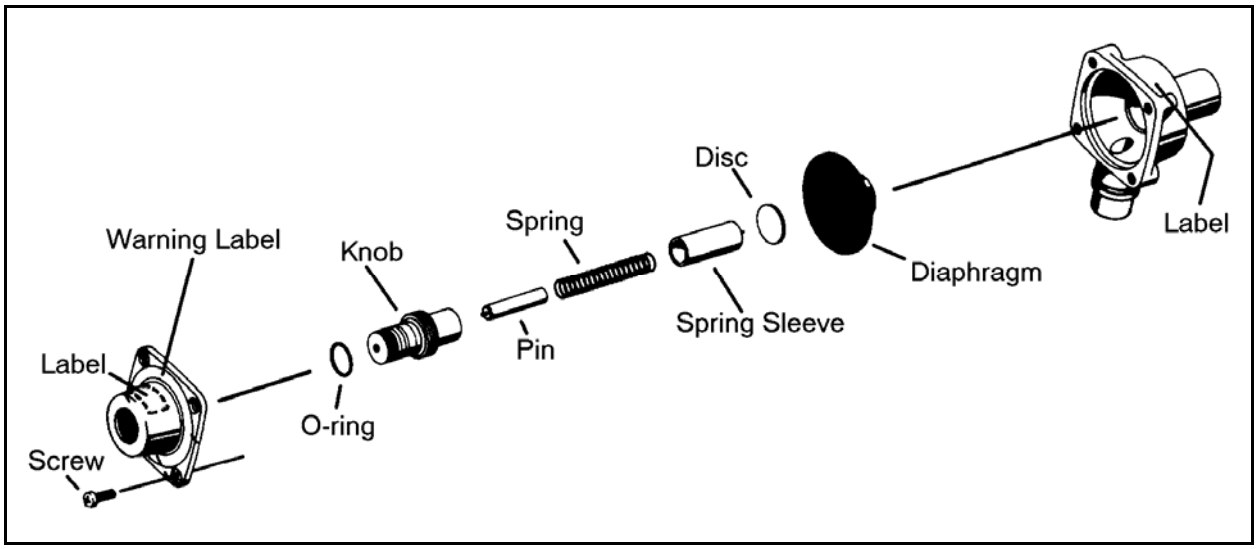


Figure 1-4. Exploded view of gas evacuator/relief valve.

(1) Disassemble the gas evacuator/relief valve.

(a) Use a Phillips screwdriver to remove the four screws from the face plate.

(b) Lift the face plate.

(c) Remove the internal components.

(2) Inspect components.

(a) Check between the housing and diaphragm for soda lime accumulation. Clean away any accumulation with warm soapy water and a soft brush. Rinse and dry thoroughly.

(b) Check for dust accumulation on the knob or nameplate. If you find any dust, you should wash, rinse, and dry the components.

(c) Check the rubber diaphragm for swelling, tackiness, or cracking. If any of these conditions is present, replace the diaphragm.

(d) Check the O-ring between the knob and the face plate for swelling, tackiness, or cracking. If any of these conditions is present, replace the O-ring.

(e) Inspect all internal components for wear. Replace any worn or damaged components.

(f) Wipe all parts with a soft, dry cloth.

(3) Lubricate as follows:

(a) Apply a thin layer of Vac Kote (Vac Kote is a trademark of the Ball Corp) to threads of the knob.

(b) Apply a thin layer of Vac Kote to the outside of the spring sleeve.

CAUTION: Never use an unauthorized lubricant.

(4) Reassemble and check out gas evacuator/relief valve ensuring the components are grit free and dry. Reassemble the components in the following order.

(a) Replace the housing.

(b) Replace the diaphragm and be sure to seat it with the Teflon plate facing the housing before remounting the face plate.

(c) Replace the disc. The new gas evacuator/relief valve disc and diaphragm are one piece, not two separate components.

(d) Replace the spring sleeve.

(e) Replace the spring.

(f) Replace the pin.

(g) Replace the knob.

(h) Replace the O-ring.

(i) Replace the face plate (mount the face plate cap with warning label facing UP).

(j) Replace the four screws.

CAUTION: Do not obstruct the air vent in the knob of the valve. This vent helps prevent a pump action from developing in the spring sleeve when gas is flowing past the diaphragm. If the valve begins to chatter or vibrate, lubricate the outside of the spring sleeve with a light film of Vac Kote.

(5) Ensure that the breathing circuit pressure gauge reads zero. If the pressure gauge does not read zero, re-zero it.

(6) Determine if the gas evacuation/relief valve relieves pressure at 2.5 mm Hg or less.

(a) Turn the knob fully counterclockwise. Force the gas out through the valve by slowly squeezing the re-breathing bag.

(b) Note the reading on the absorber pressure gauge.

(7) If it relieves pressure at a pressure higher than 2.5 mm Hg when set to the minimum pressure relief setting, determine if you properly reassembled the valve or if the spring is stretched out.

(a) If you reassembled the valve improperly, reassemble it and conduct all checks again.

(b) If the spring is stretched out, replace it.

(8) Ensure the gas evacuator/relief valve is not used until the valve has been repaired and retested.

1-6. CLEANING

Clean the anesthesia apparatus periodically or if it is dirty. Periodically clean the flow meters, the absorber, the vaporizer, and the rubber goods.

a. **Flow Meters.** Refer to figure 1-5.

(1) As required, clean the transparent flow meter shield with a soft cloth and water.

(2) Avoid using abrasive cleaners.

b. **Absorber.** Refer to Figure 1-1.

(1) Drain condensate through the absorber spigot.

(2) Clean any accumulated residue from the absorber base.

(3) For maximum gas-tightness, handle the canisters carefully so as not to dent the top sealing edge.

(4) Keep the screens free of an accumulation of soda lime.

(5) Using warm water and a stiff-bristle brush, scrub the accumulated dust from both sides of the canister bottom.

(6) Do not scrub the interior side walls of the canister. Clean with a soft cloth and warm water only.

(7) Allow the canisters to dry before refilling them with soda lime.

(8) You can remove any cloudiness which may appear on the inside of the canisters by buffing the inside with dry Bon Ami (Bon Ami is a registered trademark of Faultless Starch/Bon Ami Co.) and a soft cloth. Do not use abrasive cleaning compounds.

CAUTION: Alcohol, alcohol-base soaps and disinfectants, and liquid anesthetics tend to soften the plastic canisters.

(9) For proper tightening, turn the clamp screw until the canisters just seal against the gaskets and there are no leaks. Loosen the knob set screw and turn the knob until it contacts the cross bar. Turn the knob back until the set screw lines up with the flat side of the adjusting screw. Then tighten the set screw.

Legend

Item & Description

1. Manifold, Top
2. Kit, O_2 Flow Meter Scale, flowtube #1, w/float
3. Shield, Flow Meter
4. Head, Control Body
5. Knob, touch-coded (fluted), Oxygen only
6. O-ring
7. Sleeve
8. Screw, Cap, 1/4-20
9. Cap, Sealing w/snap
10. Kit, O_2 for Vapor. Hi-flow Containing: Scale O_2 for vaporizer (yellow), Flowtube #5 w/float
11. Kit, O_2 for vapor. Lo-flow Containing: Scale O_2 for vaporizer (yellow, Flowtube #4 w/float
12. Knob, Knurled Flow Control Valve
13. Stem, Flow Control Valve
14. Nut, Packing
15. Bonnet, Flow Control Valve
16. Gasket
17. Stud, Flow Control Valve
18. O-ring
19. Seat, Flow Control Valve
20. O-ring
21. Stop, Lower
22. Screw, 8-32
23. Kit, N_2O Flow Meter Scale, flowtube #2, w/float
24. O-ring
25. Stop, Float
26. Sleeve, Sealing
27. Gasket, Sealing Cap
28. Cap, Sealing

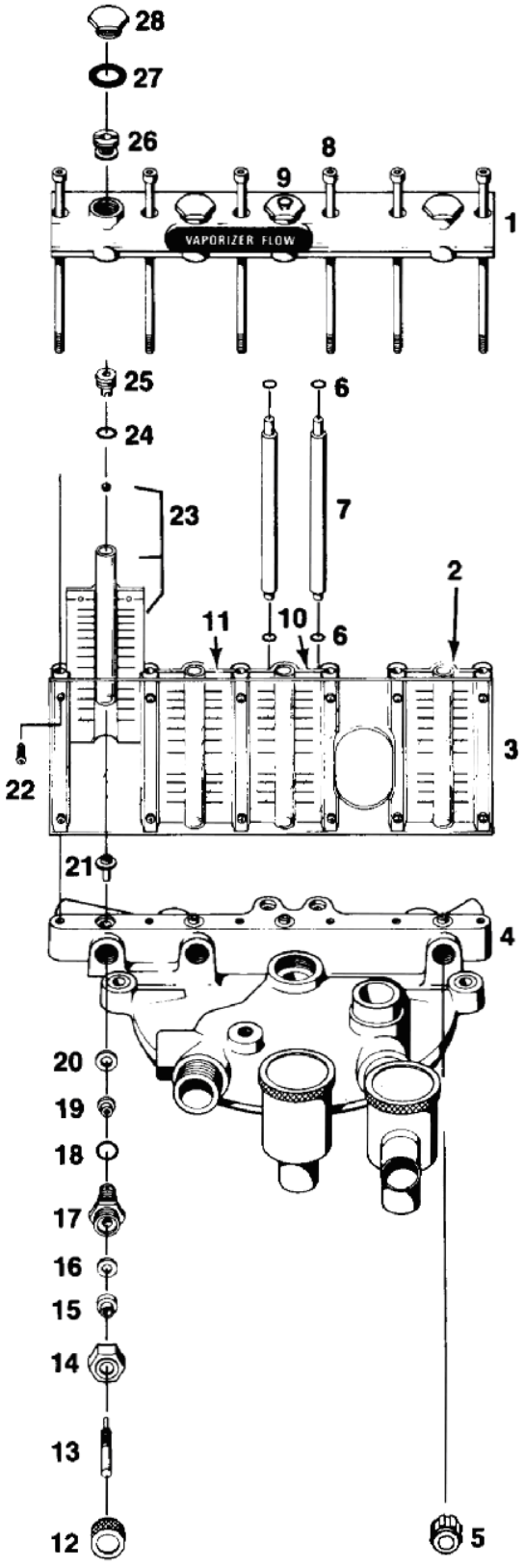


Figure 1-5. Control head-flow meters.

c. **Vaporizer.** Refer to figures 1-6 and 1-7.

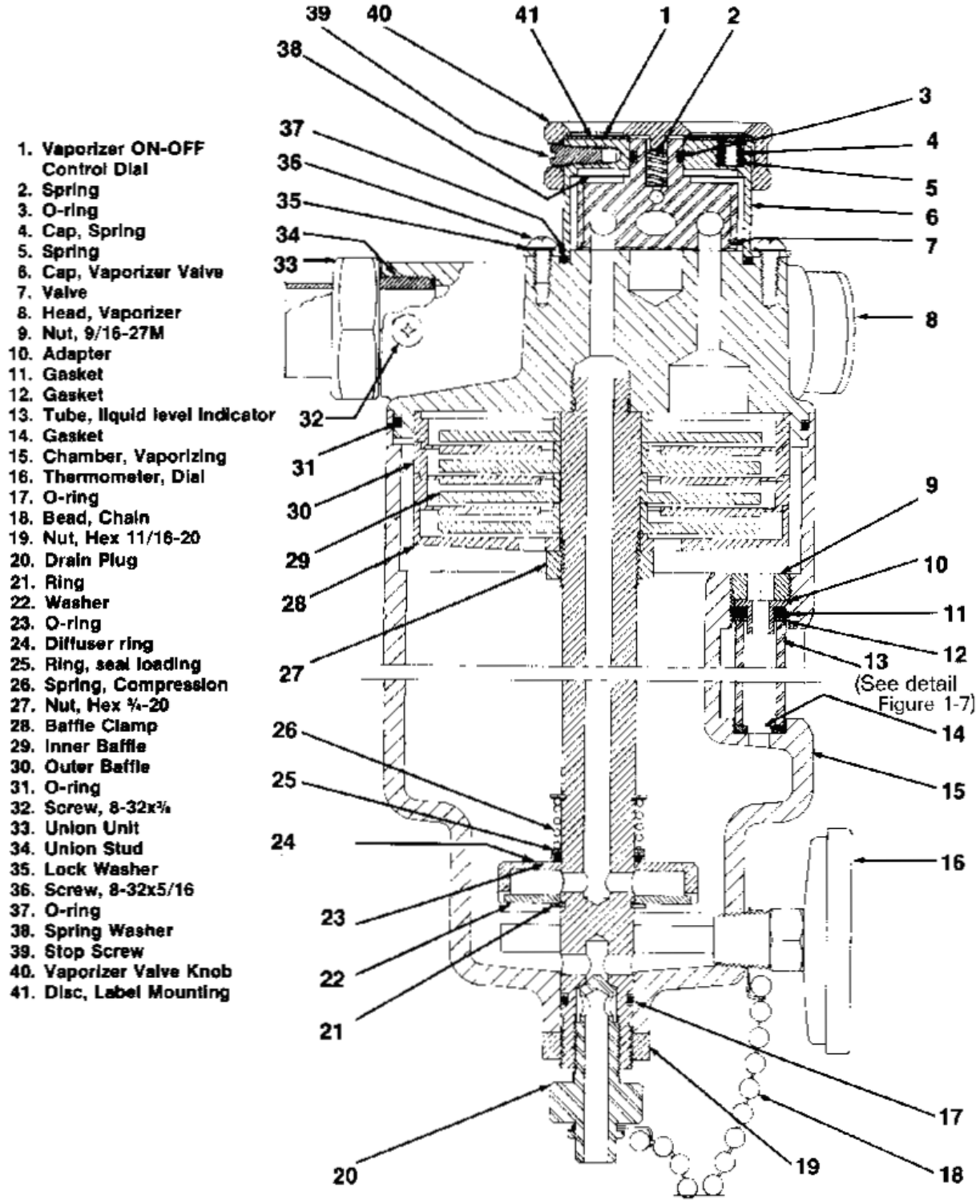
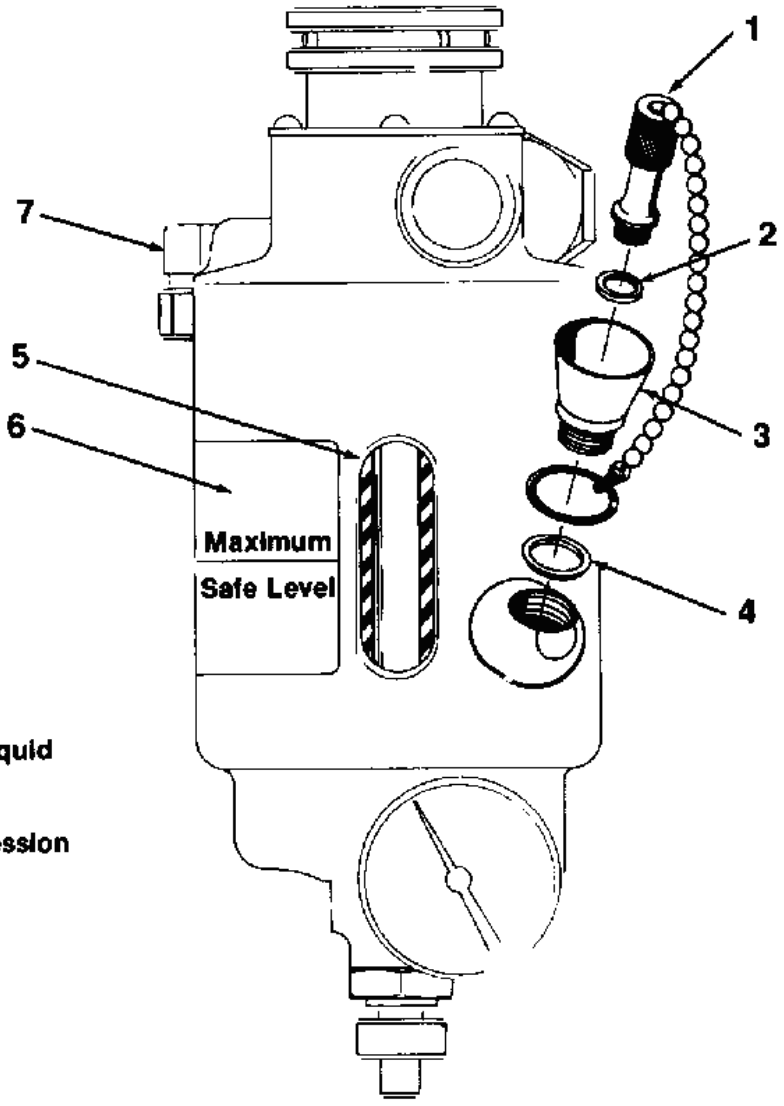


Figure 1-6. Anesthetic vaporizer.



Legend for Detail

Item & Description

1. **Funnel Plug**
2. **O-ring, Funnel Plug**
3. **Funnel**
4. **Gasket Funnel**
5. **Label, Background liquid level indicator**
6. **Label, Sightglass**
7. **Elbow, Tube Compression**

Figure 1-7. Detail for Figure 1-6.

(1) Drain the anesthetic agent from the vaporizer, if not already done, before storing the apparatus.

(2) Clean the outside of the vaporizer with soap and water.

(3) Wipe the vaporizer dry with a soft cloth.

d. **Rubber Goods.**

(1) Rubber goods (natural and synthetic) deteriorate over a period of time. The electrical conductivity of rubber goods decreases as the rubber ages. The National Fire Protection Association (NFPA) regulations (Pamphlet No. 56A) state the requirements for rubber conductivity.

(2) The presence of oxygen, ether, mineral or vegetable oils, phenols, cresols, terpenes, hydrocarbon solvents, chlorinated hydrocarbons, esters, or oxidizing acids will hasten the deterioration process. Check rubber articles often for swelling, tackiness, or cracking. When any of these conditions exist, replace the affected parts.

(3) You can prolong the useful life of rubber articles by following a program of intelligent use and care. Carry out the following suggestions when possible.

(a) If removal is required, remove the metal connectors immediately after use.

(b) When possible, store rubber articles in the dark. Store them away from sources of ozone generation such as fluorescent lighting fixtures, electric motors, and diathermy machines.

(c) To prevent tackiness, sprinkle a powder on rubber articles to be stored or steam sterilized that will come into immediate contact with each other. For this purpose, you may use talc, zinc stearate, or starch. Avoid contaminating the respiratory tract with these substances.

Continue with Exercises

EXERCISES: LESSON 1

INSTRUCTIONS: Answer the following exercises by circling the lettered response that best answers the question.

After you have answered all of the exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers. For each exercise answered incorrectly, reread the lesson material referenced after the solution.

1. Which of the following statements describes in part how an anesthesia apparatus operates?

   a. Oxygen and nitrous oxide cylinders provide the gas supply directly to the system without need for regulators.

   b. Nitrous oxide gas serves as the vehicle to carry anesthetic vapor from the vaporizer to the patient.

   c. The absorber captures carbon dioxide and recycles it into the breathing circuit.

   d. Relief valves release excess gas into the atmosphere if pressure within the breathing circuit exceeds a set level.

2. Which of the following statements describes in part how to perform an operational checkout of the Ohmeda anesthesia unit?

   a. When you connect the nitrous line to the gas cylinder, turn on the N_2O flow meter valve, and disconnect the oxygen line from the cylinder, the nitrous ball in the N_2O flow meter must rise.

   b. When you connect the oxygen line to the gas cylinder, press the oxygen flush, and observe the pressure gauge, it should drop slowly as you pressurize the system.

   c. When you pressurize the system to 25 cm H_2O and release the oxygen flush, the system should hold pressure with the vaporizer ON and OFF.

   d. When you put your hand over the vaporizer outlet (replacing a disconnected inhalation hose) and push the oxygen flush, the pressure relief valve should not relieve pressure.

3. You use the nonadjustable pressure relief valve pop-off test to verify if which of the following occurs?

    a. The nonadjustable pressure relief valve will open when pressure builds up within the breathing circuit.

    b. The nonadjustable pressure relief valve will close when pressure builds up within the breathing circuit.

    c. The nonadjustable pressure relief valve will allow nitrous oxide into the common passage where it mixes with metabolic oxygen.

    d. The nonadjustable pressure relief valve will admit oxygen to the O_2 for the vaporizer flow control valve and flow meter.

4. When zeroing the breathing circuit pressure gauge, which of the following steps do you perform?

    a. Lay the apparatus on its side to perform all steps.

    b. Adjust the small slotted screw under the edge of the gauge body until the gauge pointer rests at zero.

    c. Remove the face plate of the breathing circuit pressure gauge and move the gauge pointer to the zero on the gauge.

    d. Turn the knurled knob at the bottom of the breathing circuit pressure gauge to move the gauge pointer to its baseline.

5. Which of the following statements is true regarding the leak test procedures?

    a. Perform leak tests on a monthly basis.

    b. Ensure all gauges work properly.

    c. Perform leak tests before each usage.

    d. Use leak tests primarily to check breathing bags.

6. Which of the following statements is true about changing the soda lime in the absorber canisters?

   a. You must change the soda lime within 4 hours of use, after a color change begins in the lower canister.

   b. You keep the freshest soda lime in the top canister, because carbon dioxide flows downward.

   c. You can reliably judge the color of the soda lime at any time before its use.

   d. You must dispose of all old soda lime and place a fresh supply in both the top and bottom canisters.

7. Which of the following statements is a caution you should observe when performing check valve maintenance to ensure valves are clean?

   a. Never wipe the seat with anything except ether.

   b. Do not obstruct the air vent in the knob of the valve.

   c. Do not pull on the valve disc.

   d. Do not use soapy water.

8. Which of the following statements describes in part how to perform gas evacuator/relief valve maintenance?

   a. Clean the relief valve parts with only a soft brush; do not use soap and water.

   b. When reassembling the valve, stretch out the spring as far as it will go.

   c. Replace the face plate and mount the cap with the warning label facing DOWN.

   d. Ensure the breathing circuit pressure gauge reads zero and verify that the valve relieves pressure at 2.5 mm Hg or less.

9. Which of the following statements describes how to clean the anesthesia apparatus part mentioned?

   a. Clean the transparent flow meter shield with a mildly abrasive cleaner.

   b. Clean the vaporizer, both inside and out, with soapy water.

   c. Do not scrub the interior side walls of the absorber canisters.

   d. Use alcohol or alcohol-base soaps to clean the absorber canisters.

10. Which of the following statements describes procedures that prolong the useful life of rubber articles?

   a. Leave metal connectors attached after removal of rubber articles.

   b. Store rubber articles away from fluorescent lighting fixtures.

   c. Powder rubber articles with a soda lime compound to prevent tackiness.

   d. Clean with a vegetable oil, cresol, or hydrocarbon solvent.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES: LESSON 1

1. d (para 1-2b(2)(d))
2. c (paras 1-3a(8), (9))
3. a (para 1-3b(7))
4. b (paras 1-3c(2), (3))
5. c (para 1-3d)
6. a (para 1-5a)
7. c (para 1-5b(2)(c))
8. d (para 1-5c(6))
9. c (para 1-6b(6))
10. b (para 1-6d(3)(b))

End of Lesson 1

LESSON ASSIGNMENT

LESSON 2	Perform Calibration/Verification of Anesthesia Apparatus.
TEXT ASSIGNMENT	Paragraphs 2-1 through 2-3.
LESSON OBJECTIVES	After you have completed this lesson, you should be able to:

2-1. Identify the procedures required to calibrate/ verify the anesthesia apparatus.

2-2. Identify the common actions required to correct deficiencies identified during calibration/ verification of the anesthesia apparatus.

2-3. Identify the purpose for calibration/verification of the anesthesia apparatus.

SUGGESTION Work the lesson exercises at the end of this lesson before beginning the next lesson. These exercises will help you accomplish the lesson objectives.

LESSON 2

PERFORM CALIBRATION/VERIFICATION OF ANESTHESIA APPARATUS

2-1. GENERAL

In this lesson, you will learn how to calibrate the field anesthesia apparatus. When you calibrate the field anesthesia apparatus, you verify that its output is accurate to within the manufacturer's specifications. You verify the calibration of the field anesthesia apparatus by comparing the output shown on the anesthesia gauges against a known standard. The known standard is the RT200 Calibration Analyzer. The measurements you make indicate whether the anesthesia apparatus under inspection is worthy of being in service. You perform calibration/verification when you initially place the unit in service and anytime you repair or replace any component. You also perform calibration/verification periodically in accordance with local guidelines. If the unit fails calibration, you must repair the unit before you return it to service. A properly calibrated apparatus is essential to ensuring that the anesthetist can safely administer anesthetics. Calibration/verification of the anesthesia unit ensures that it is safe to use during surgery.

2-2. PERFORMING CALIBRATION/ VERIFICATION

Perform calibration/verification on the flow tubes by reading the flow meter gauges. Perform calibration/verification on the re-breathing circuit by reading the re-breathing circuit pressure gauge. Before you start calibrating, attach the O_2 and N_2O cylinders to the Ohmeda 885A. Close the system by connecting the RT200 to the anesthesia apparatus. These functional tests allow you to ensure outputs are accurate. Refer to the RT200 manual for hook-up instructions.

a. **Checking the Flow Tubes.** The function test chart (figure 2-1) shows the tests you use to calibrate/verify the anesthesia apparatus. You must check both the N_2O and the O_2 flow tubes at 1 lpm (liter per minute), at 4 lpm, and at 7 lpm. You check the vaporizer flow tubes at 0.2 lpm, at 0.5 lpm, and at 1 lpm. For example, to calibrate/verify the N_2O flow tube, you supply N_2O to the apparatus. Then conduct function test 33 at 1 lpm and at 4 lpm; then conduct function test 37 at 7 lpm. When the flow shown on the flow tube reaches the level in lpm as indicated on the chart, record the readings on the RT200. You then determine if the difference between the readings on the RT200 and the flow tube is within the limits of the manufacturer's literature. If the readings are within the limits, you should proceed to calibrate the O_2 and vaporizer flow tubes. If the readings are not within the limits, the flow tube must be repaired or replaced. To calibrate the O_2 flow tube and the vaporizer flow tubes, repeat the procedure above with O_2 supplied to the anesthesia apparatus (with no N_2O supplied). Each flow tube must successfully complete calibration/verification before you return the anesthesia apparatus to service.

FLOW IN LITERS PER MINUTE (lpm)									
FUNCTION TEST	N_2O			O_2			VAPORIZER FLOW		
	1	4	7	1	4	7	.2	.5	.1
31				●	●		●	●	●
33	●	●		●	●		●	●	●
35						●			
37			●			●			

Figure 2-1. Function tests.

(1) You test each tube at three different pressures using different function tests. In order to get accurate readings, you must use the correct gas when performing a particular test.

(2) To test the N_2O flow tube:

(a) Turn on the O_2 gas to a minimum of 30 psi.

(b) Turn on the N_2O gas.

(c) Input test 33 on the RT200.

(d) Record readings on the RT200 when the N_2O flow meter gauge reads 1 lpm and 4 lpm.

(e) Input test 37 on the RT200.

(f) Record the reading on the RT200 when the N_2O flow meter gauge reads 7 lpm.

(3) To test the O_2 flow tube:

(a) Turn off the N_2O gas and turn on the O_2 gas.

(b) Input test 31 on the RT200.

(c) Record the readings on the RT200 when the O_2 flow meter gauge is at 1 lpm and at 4 lpm.

(d) Input test 33 on the RT200.

(e) Record the readings on the RT200 when the O_2 flow meter gauge is at 1 lpm and at 4 lpm.

(f) Input test 35 on the RT200.

(g) Record the reading on the RT200 when the O_2 flow meter gauge reads 7 lpm.

(h) Input test 37 on the RT200.

(i) Record the reading on the RT200 when the O_2 flow meter reads 7 lpm.

(4) To test the O_2 for vaporizer flow tubes:

(a) Turn on the O_2 gas, only.

(b) Input test 31 on the RT200.

(c) Record all readings on the RT200 when the O_2 for vaporizer flow meter gauges (high and low flow) reads 0.2 lpm, 0.5 lpm, and 1 lpm.

(d) Input test 33 on the RT200.

(e) Record all readings on the RT200 when the O_2 for vaporizer flow meter gauges (high and low flow) reads 0.2 lpm, 0.5 lpm, and 1 lpm.

(5) Compare all readings to manufacturer's specifications for the specific flow tube.

b. **Checking the Pressure Gauge.** You also calibrate/verify the breathing circuit pressure gauge with three separate tests. Because these are all low range pressures, you use test 11 to verify the gauge reading at 10 cm H_2O. You use test 12 to verify the reading at 30 cm H_2O and 60 cm H_2O. (The O_2 flow may need to be turned on slightly to establish a consistent pressure.) You record the analyzer readings at each level and compare the readings to the manufacturer's specifications.

2-3. CORRECTIVE ACTION

You must take corrective action if any flow tube or the breathing circuit pressure gauge fails any test.

a. **Corrective Action for Flow Tube Failure.** If the flow tube fails to calibrate, execute the following steps in the order given.

(1) Step 1.

(a) Remove the valve stem and seat of the affected flow tube.

(b) Replace the valve stem and seat of the affected flow tube.

(c) Recheck the calibration.

(d) Execute step 2 if the flow tube fails to calibrate.

(2) Step 2.

(a) Remove the entire flow tube assembly (flow tube, float, gaskets, scale, and seals) affected.

(b) Replace the entire flow tube assembly.

(c) Recalibrate the unit.

(d) Evacuate the unit to depot level maintenance if the unit still fails to calibrate. To do this, you must prepare a work order for depot maintenance, repack the unit in a shipping container with the work order inside, and send it.

b. **Corrective Action for Pressure Gauge Failure.** Replace the gauge if it is reading inaccurately during any of the tests. Refer to the manufacturer's service literature or the manufacturer's service representative for further information on replacing malfunctioning components of the anesthesia apparatus.

Continue with Exercises

EXERCISES: LESSON 2

INSTRUCTIONS: Answer the following exercises by circling the lettered response that best answers the question.

After you have answered all of the exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers. For each exercise answered incorrectly, reread the lesson material referenced after the solution.

1. Which of the following statements is true about performing calibration on the Ohmeda 885A anesthesia apparatus?

   a. You check the output of the field anesthesia apparatus absorber and breathing bag.

   b. You check the output of the field anesthesia apparatus flow tubes and re-breathing circuit pressure gauge.

   c. You verify the flow of anesthetic vapors to the patient via the inhalation breathing tube.

   d. You verify gas cylinder gauge readings against a known standard, the RT200 Calibration Analyzer.

2. Refer to the functional tests figure below. Which test do you use to test N_2O at 7 lpm?

   a. Function test 31.

   b. Function test 33.

   c. Function test 35.

   d. Function test 37.

FLOW IN LITERS PER MINUTE (lpm)									
FUNCTION TEST	N_2O			O_2			VAPORIZER FLOW		
	1	4	7	1	4	7	.2	.5	.1
31				●	●		●	●	●
33	●	●		●	●		●	●	●
35						●			
37			●			●			

3. At what levels of cm H_2O do you check the breathing circuit pressure gauge?

   a. 10cm H_2O and 60cm H_2O.

   b. 5cm H_2O, 10cm H_2O, and 30cm H_2O.

   c. 10cm H_2O, 30cm H_2O, 60cm H_2O.

   d. 1 lpm, 4 lpm, and 7 lpm.

4. If a flow tube fails a test, you initially take which of the following corrective actions?

   a. Replace the entire affected assembly.

   b. Remove and replace the valve stem and valve seat, then recheck the calibration.

   c. Repack the unit in a shipping container with the work order inside and evacuate it to depot level maintenance.

   d. Tighten the packing on the valve stem.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES: LESSON 2

1. b (para 2-2)
2. d (paras 2-2a(2)(e), (f))
3. c (para 2-2b)
4. b (paras 2-3a(1)(a), (b), (c))

End of Lesson 2

LESSON ASSIGNMENT

LESSON 3	Isolate Malfunctions to Component Level in Anesthesia Apparatus.
TEXT ASSIGNMENT	Paragraphs 3-1 through 3-8.
LESSON OBJECTIVES	When you have completed this lesson, you should be able to:

3-1. Identify warnings and cautions to observe when you are isolating malfunctions to the anesthesia apparatus.

3-2. Identify the procedures required to isolate common malfunctions to the anesthesia apparatus.

SUGGESTION Work the lesson exercises at the end of this lesson before beginning the next lesson. These exercises will help you accomplish the lesson objectives.

LESSON 3

ISOLATE MALFUNCTIONS TO COMPONENT LEVEL IN ANESTHESIA APPARATUS

3-1. GENERAL

Maintaining the anesthesia apparatus in a safe operating condition is essential to the safe administration of anesthetics. As a medical equipment repairer, your ability to isolate the cause of a field anesthesia unit malfunction determines the availability of the apparatus. In this lesson, you will review how to isolate causes for a variety of malfunctions found when you performed PMCS or calibrated the anesthesia apparatus. Refer to figure 3-1, Adult re-breathing circuit, and figure 3-2, Pediatric partial re-breathing circuit, throughout this lesson.

3-2. WARNINGS AND CAUTIONS

Whenever you are working on an anesthesia apparatus, remember that the anesthesia apparatus employs combustible and explosive gases at high pressure. Additionally, you must observe the following warnings and cautions.

WARNINGS

Never mix two or more agents in the vaporizer when filling or cleaning it. This mixing could result in an unpredictable chemical reaction.

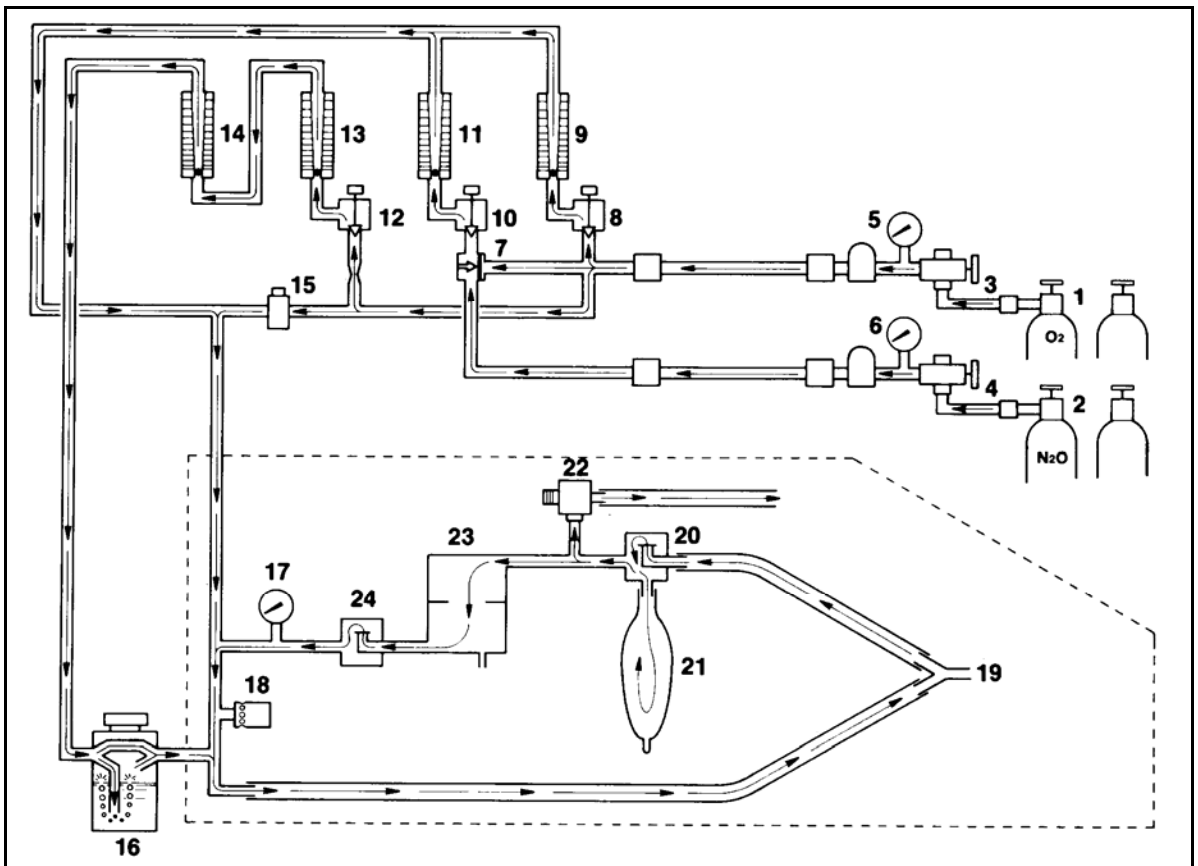
Always drain and dry the liquid agent from the vaporizer before adding another agent.

Never drain liquid anesthetic into an unmarked container for storage. Drain the anesthetic into a container labeled with the name of the agent, or discard it immediately.

CAUTIONS: Do not overtighten the absorber clamp screw. Overtightening could cause the canisters to warp.

Do not obstruct the air vent in the knob of the cylinder valve. This vent helps prevent a pump action from developing in the spring sleeve when gas is flowing rapidly past the diaphragm.

Do not use organic based thread sealants on any portion on the oxygen regulator. Use only Teflon thread-sealing tape or thread compound.



Legend for Figure 3-1

1. O_2 Cylinder
2. N_2O Cylinder
3. O_2 Cylinder Adapter
4. N_2O Cylinder Adapter
5. O_2 Regulator Assembly
6. N_2O Regulator Assembly
7. Pressure Sensor Valve
8. O_2 Flow Control Valve
9. O_2 Flow Meter
10. N_2O Flow Control Valve
11. N_2O Flow Meter
12. O_2 for Vaporizer Flow Control Valve
13. O_2 for Vaporizer Flow Meter (low flow)
14. O_2 for Vaporizer Flow Meter (high flow)
15. O_2 Flush Valve
16. Anesthetic Vaporizer
17. Breathing Circuit Pressure Gauge
18. Pressure Relief Valve (non-adjustable)
19. Y-Connector
20. Exhalation Check Valve
21. Breathing Bag (3 liter)
22. Gas Evacuator/Relief Valve
23. Absorber
24. Inhalation Check Valve

Figure 3-1. Adult re-breathing circuit.

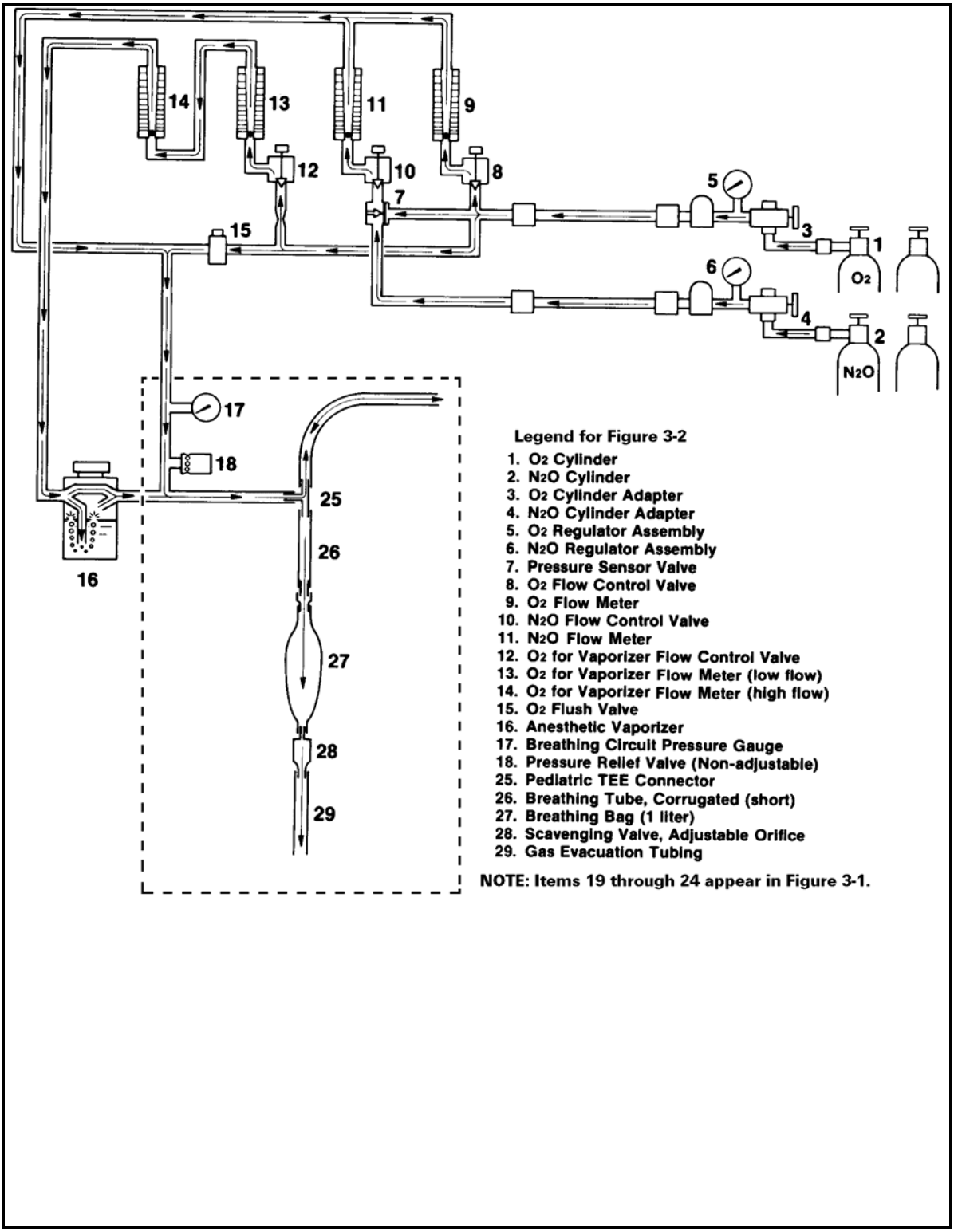


Figure 3-2. Pediatric partial re-breathing circuit.

3-3. ISOLATE A NONADJUSTABLE PRESSURE RELIEF VALVE MALFUNCTION

When you are performing the nonadjustable pressure relief valve "pop-off" test, the nonadjustable pressure relief valve may stick or operate intermittently. If this happens, you must trouble-shoot for the malfunction. Refer to figure 3-3.

CAUTION: No repair should ever be undertaken or attempted by anyone who is not trained in repairing devices of this nature.

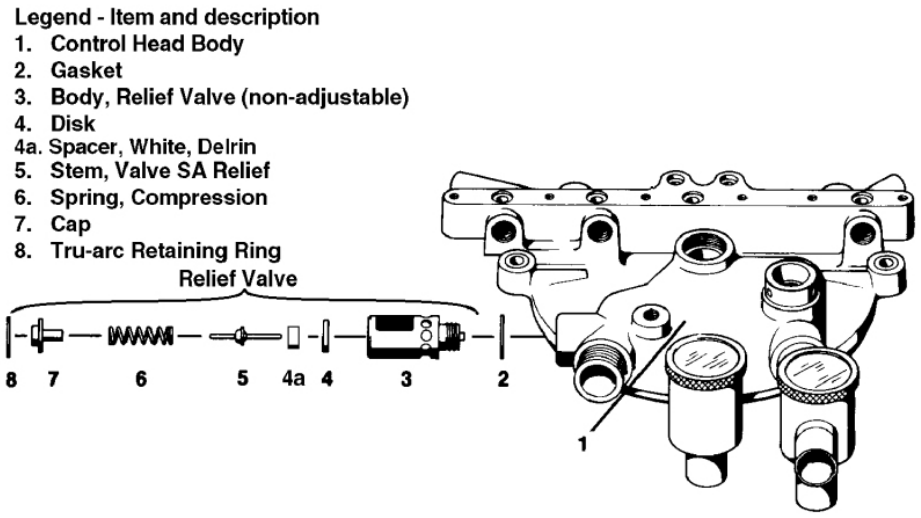


Figure 3-3. Control head.

a. Place a small screwdriver through one of the vent holes and carefully attempt to un-stick the valve.

b. Disassemble the valve for cleaning and repair if the valve continues to stick or operate intermittently.

(1) Disassemble the pressure relief valve. Inspect the parts for wear and/or damage during disassembly.

(a) Remove the Tru-arc retaining ring.

(b) Remove the cap.

(c) Remove the compression spring.

(d) Remove the pressure relief valve stem.

(e) Remove the pressure relief valve body.

(f) Remove the gasket.

(2) Wipe all parts clean with a dry, lint-free cloth including the portion of the control head body from which you removed the pressure relief valve.

(3) Reassemble the pressure relief valve in reverse order of disassembly.

3-4. ISOLATE A BREATHING CIRCUIT PRESSURE GAUGE MALFUNCTION

If the breathing circuit pressure gauge malfunctions, troubleshoot it by using the following procedures. Refer to figure 3-1.

a. Place the apparatus in an upright position.

b. Adjust the gauge to zero ±1 mm Hg.

c. If the gauge will not adjust to zero ±1 mm Hg, the gauge is defective .

d. Remove and replace or repair a defective breathing circuit pressure gauge before returning the anesthesia device to service.

3-5. ISOLATE A LEAK DURING LEAK TEST PROCEDURE NUMBER 1

When you are performing leak test procedure number 1, the pressure may drop faster than normal. You must troubleshoot the malfunction. For large cylinders, abnormal pressure drops are more than 100 psig per 7-minute period. For small cylinders, abnormal pressure drops are more than 100 psig per 5-minute period. Refer to figure 3-4 for small cylinder use. Refer to figure 3-5 for large cylinder or primary/backup use.

a. Perform leak test procedure number 1.

(1) If you are using an adapter, tighten the cylinder adapter securely on the cylinder.

(2) Ensure the cylinder gasket is in place on the cylinder valve or cylinder adapter.

(3) Replace any gasket that appears to be nicked or worn.

b. Repeat leak test number 1.

(1) Proceed to leak test number 2 if the apparatus can meet the stated specifications.

(2) Perform the following steps if the apparatus cannot meet stated specifications.

(a) Disconnect the gas supply hose from the regulator assembly.

(b) Repeat steps 2 through 4 of leak test number 1.

(c) If the stated specifications are then met, the leak is in the supply hose or supply hose connections. Remove and replace or repair the supply hose or supply hose connections before returning the anesthesia device to service.

(d) If the stated specifications are still not met, the leak is in the regulator assembly. Remove and replace or repair the regulator assembly before returning the anesthesia device to service.

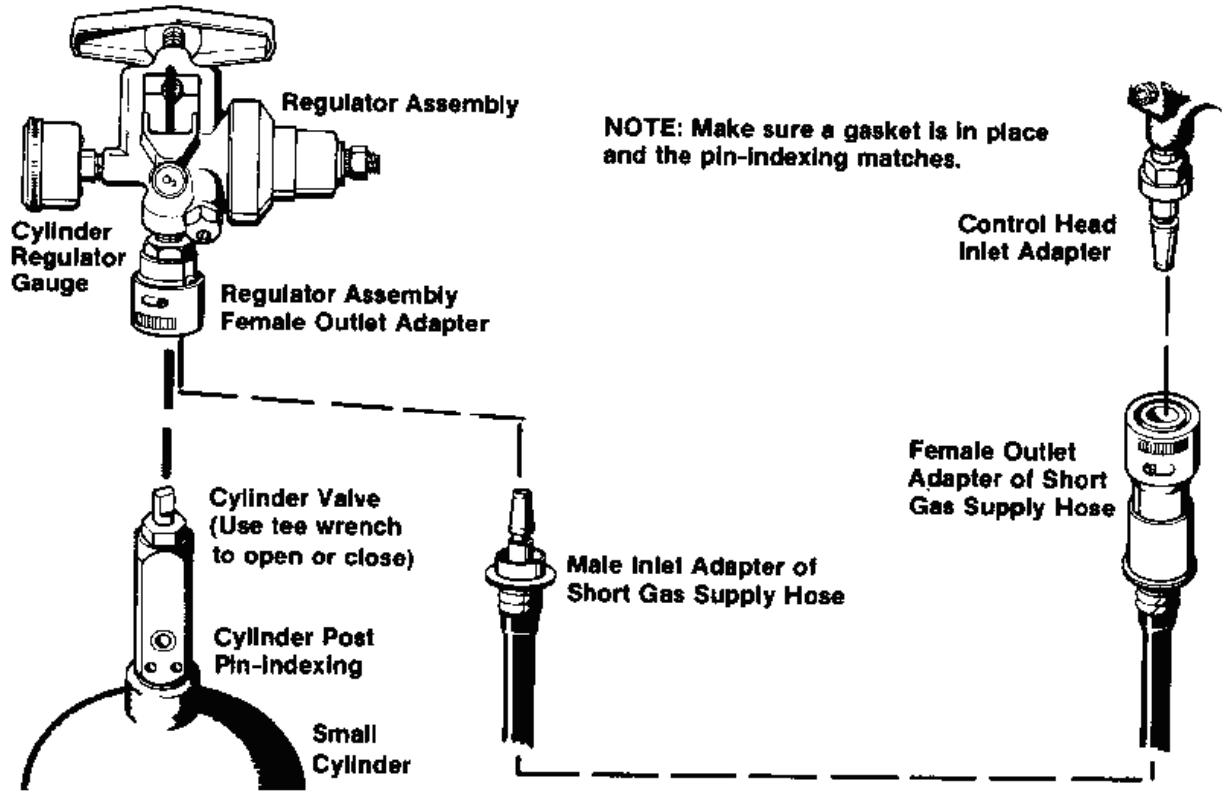

Regulator Assembly
Cylinder Regulator Gauge
Regulator Assembly Female Outlet Adapter
NOTE: Make sure a gasket is in place and the pin-indexing matches.
Control Head Inlet Adapter
Female Outlet Adapter of Short Gas Supply Hose
Cylinder Valve (Use tee wrench to open or close)
Male Inlet Adapter of Short Gas Supply Hose
Cylinder Post Pin-indexing
Small Cylinder

Figure 3-4. Supply hose connections for small cylinder use

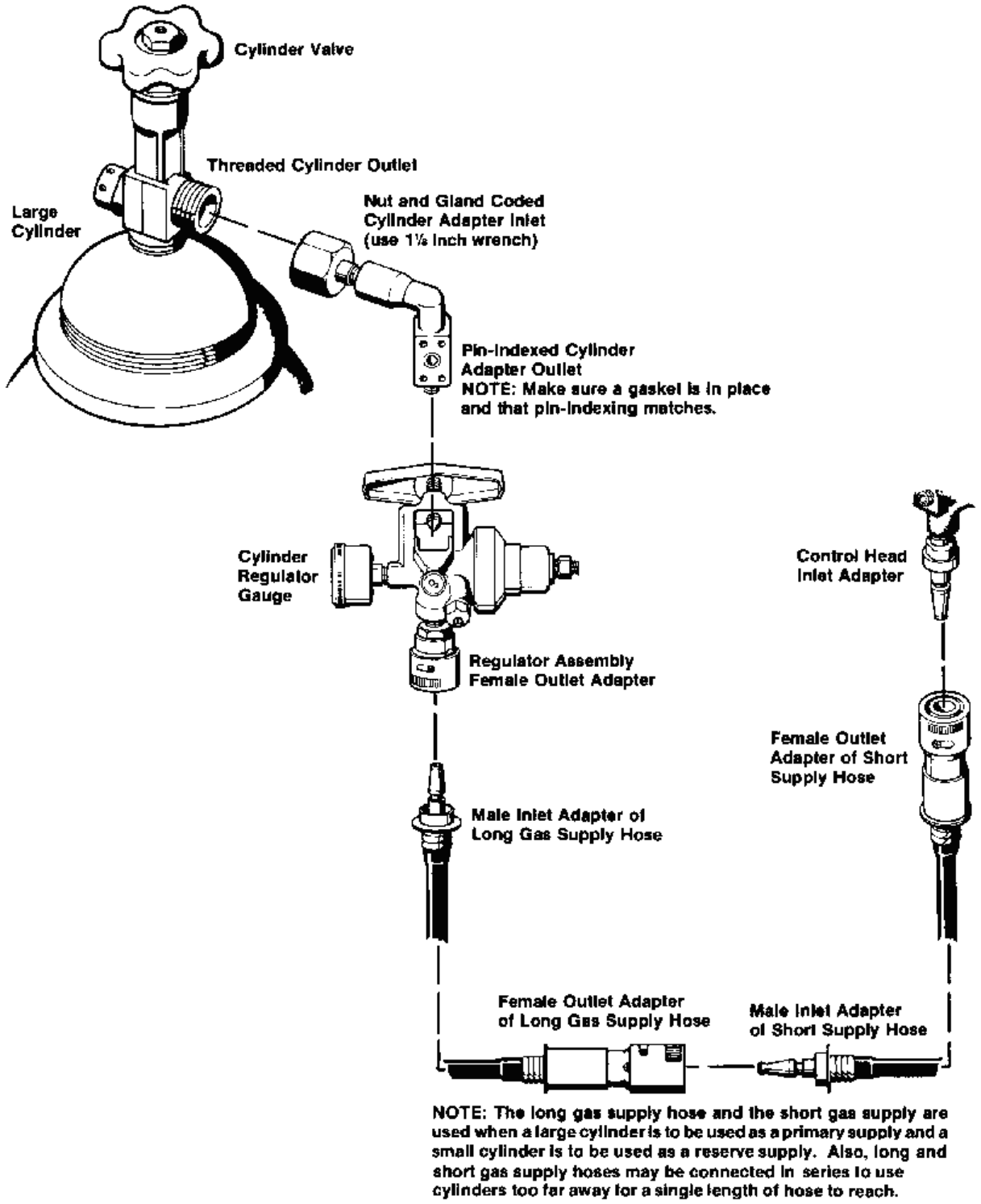

Cylinder Valve
Threaded Cylinder Outlet
Large Cylinder
Nut and Gland Coded Cylinder Adapter Inlet (use 1⅛ inch wrench)
Pin-Indexed Cylinder Adapter Outlet
NOTE: Make sure a gasket is in place and that pin-indexing matches.
Cylinder Regulator Gauge
Regulator Assembly Female Outlet Adapter
Male Inlet Adapter of Long Gas Supply Hose
Control Head Inlet Adapter
Female Outlet Adapter of Short Supply Hose
Female Outlet Adapter of Long Gas Supply Hose
Male Inlet Adapter of Short Supply Hose
NOTE: The long gas supply hose and the short gas supply are used when a large cylinder is to be used as a primary supply and a small cylinder is to be used as a reserve supply. Also, long and short gas supply hoses may be connected in series to use cylinders too far away for a single length of hose to reach.

Figure 3-5. Supply hose connections for large cylinder or primary/backup use.

3-6. ISOLATE A LEAK DURING LEAK TEST PROCEDURE NUMBER 2

When you are performing leak test number 2 and the flow meter shows a flow after you close the cylinder valves, you must troubleshoot the malfunction. Refer to figure 3-6.

a. Ensure that you have closed the flow control valve to its stop.

b. If you have closed the flow control valve and flow is still shown on the flow meter, the flow control valve is defective. Remove and replace or repair the flow control valve before returning the anesthesia device to service.

3-7. ISOLATE A LEAK DURING LEAK TEST PROCEDURE NUMBER 3A AND NUMBER 3B

If you are performing leak tests numbers 3A and 3B and the pressure does not rise normally, there is a malfunction. With the adult re-breathing circuit (leak test 3A), the pressure should rise to at least 35 mm Hg. With the pediatric partial re-breathing circuit (leak test 3B), the breathing circuit pressure gauge should rise to 35 mm Hg or higher. To troubleshoot the malfunction, perform the following procedure. Refer to Figure 3-3.

a. Attempt to correct a leak.

(1) Align the absorber canisters making sure they fit snugly against the gaskets. Tighten the clamp screw being careful not to over tighten.

(2) Make sure you have secured all hose and tubing connections.

(3) Make sure that any protective closure devices you used in the test fit tightly.

(4) Make sure you have securely tightened the vaporizer funnel plug and drain spigot.

(5) Fully close the gas evacuator/relief valve.

(6) Make sure the threads on the neck of the breathing circuit pressure gauge fit securely into the control head casting.

(7) Make sure you have securely tightened all fittings and connectors.

(8) Make sure you have tightened the inhalation and exhalation check valve window knurled ring retainers.

(9) Make sure you have tightened the absorber drain spigot.

Legend

Item & Description

1. Manifold, Top
2. Kit, O_2 Flowmeter Scale, flowtube #1, w/float
3. Shield, Flowmeter
4. Head, Control Body
5. Knob, touch-coded (fluted), Oxygen only
6. O-ring
7. Sleeve
8. Screw, Cap
9. Cap, Sealing w/snap
10. Kit, O_2 for Vapor. Hi-flow Containing: Scale O_2 for vaporizer (yellow), Flowtube #5 w/float
11. Kit, O_2 for vapor. Lo-flow Containing: Scale O_2 for vaporizer (yellow, Flowtube #4 w/float
12. Knob, Knurled Flow Control Valve
13. Stem, Flow Control Valve
14. Nut, Packing
15. Bonnet, Flow Control Valve
16. Gasket
17. Stud, Flow Control Valve
18. O-ring
19. Seat, Flow Control Valve
20. O-ring
21. Stop, Lower
22. Screw
23. Kit, N_2O Flow Meter Scale, flowtube #2, w/float
24. O-ring
25. Stop, Float
26. Sleeve, Sealing
27. Gasket, Sealing Cap
28. Cap, Sealing

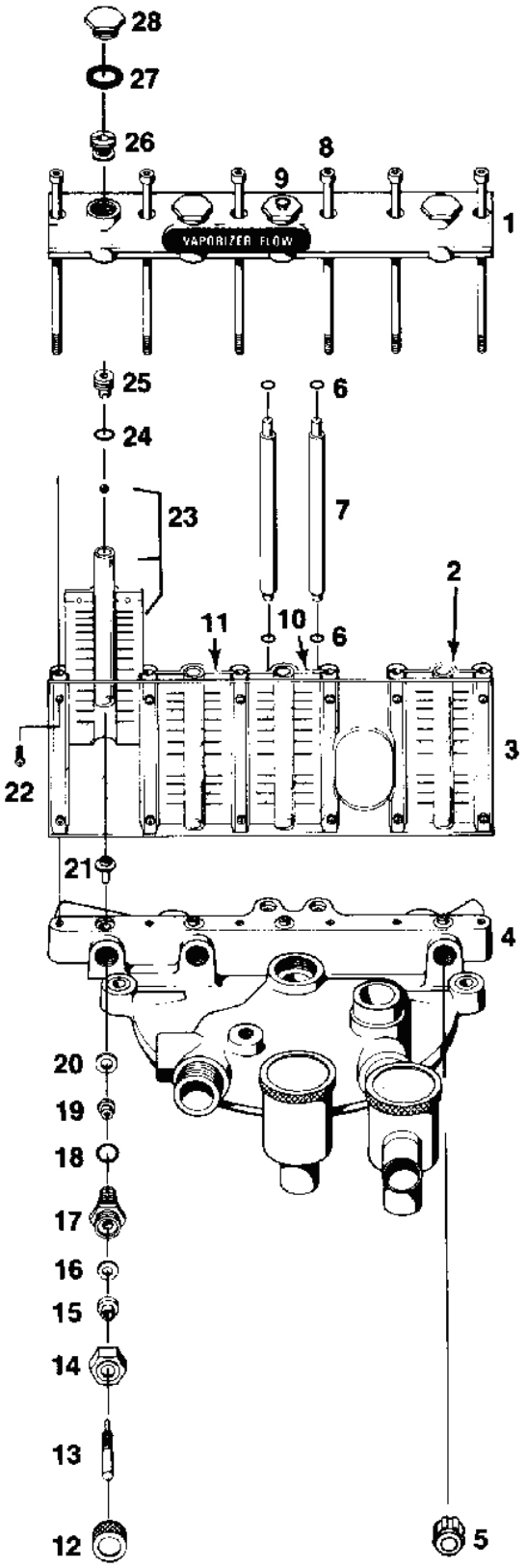


Figure 3-6. Control head - flow meters.

b. After you have made all the checks listed above, perform the appropriate leak test procedure again.

(1) If the circuit meets all leak test procedure specifications, the apparatus may be used.

(2) If the circuit cannot meet the specifications, you must repair the circuit before returning the anesthetic device to service.

NOTE: Applying a soap solution to suspected joints while the circuit is under pressure may reveal the leak.

3-8. ISOLATE A SCAVENGING VALVE MALFUNCTION

Refer to figure 3-2. When you are performing the last step of leak test number 3B (release the breathing bag nipple and adjust the oxygen flow to 500 cc/minute), the breathing circuit gauge may exceed 3 mm Hg. This indicates that the scavenging valve is not opening properly. You must repair or replace it before returning the anesthetic device to service.

Continue with Exercises

EXERCISES: LESSON 3

INSTRUCTIONS: Answer the following exercises by circling the lettered response that best answers the question.

After you have answered all of the exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers. For each exercise answered incorrectly, reread the lesson material referenced after the solution.

1. You are isolating a malfunction in the nonadjustable pressure relief valve. Which of the following statements is correct?

   a. Increase the pressure to 500 cc/minute to force the nonadjustable pressure relief valve to operate.

   b. Stretch the compression spring as far as it will go to free a sticking nonadjustable pressure relief valve.

   c. Gently wiggle the valve inside the pressure relief valve body to free the pressure relief valve from sticking.

   d. Place a small screwdriver through one of the pressure relief valve vent holes and carefully attempt to un-stick the valve.

2. You are isolating a breathing circuit pressure gauge malfunction. Which of the following statements is correct?

   a. If the breathing circuit pressure gauge will not adjust to +/-10 mm Hg, you must replace or repair it.

   b. If the breathing circuit pressure gauge operates only when the apparatus is upright, you must replace or repair it.

   c. If the breathing circuit pressure gauge will not adjust to zero +/-1 mm Hg, you must replace or repair it.

   d. If the breathing circuit pressure gauge requires adjusting to zero, you must replace the gauge.

3. Which of the following is an abnormal pressure drop when performing leak test procedure number 1 that would require you to troubleshoot a malfunction?

   a. For large cylinders, over 100 psig per 7-minute period.

   b. For large cylinders, over 50 psig per 7-minute period.

   c. For small cylinders, over 100 psig per 5-minute period.

   d. For small cylinders, over 50 psig per 12-minute period.

4. You are troubleshooting a malfunction found in leak test procedure number 2. You have closed the flow control valve to its stop. Which of the following statements describes the probable reason why a flow meter would still show a flow?

   a. The cylinder valves are still open.

   b. The supply hoses are incorrectly connected.

   c. The flow control valve needs repair.

   d. The regulator assembly is faulty.

5. While performing leak test procedures numbers 3A and 3B, you discovered that the pressure did not rise normally. Which of the following procedures do you use to troubleshoot the cause?

   a. Tighten the absorber clamp screw being careful not to over tighten.

   b. Open the gas evacuator/relief valve to allow the pressure to rise normally.

   c. Loosen the absorber drain spigot so condensate can drain properly.

   d. Verify you have removed any protective closure devices used in the test.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES: LESSON 3

1. d (para 3-3a)
2. c (para 3-4c,d)
3. a (para 3-5)
4. c (para 3-6b)
5. a (para 3-7a(1))

End of Lesson 3

LESSON ASSIGNMENT

LESSON 4	Remove and Replace or Repair Defective Components of Anesthesia Apparatus.
TEXT ASSIGNMENT	Paragraphs 4-1 through 4-4.
LESSON OBJECTIVES	After you have completed this lesson, you should be able to:

4-1. Identify the warnings and cautions to observe when you are removing and replacing or repairing defective components of anesthesia apparatus.

4-2. Identify the procedures required to remove and replace or repair these defective components: flow control valves; flow meter tube, scale, and float; and check valve disc.

SUGGESTION Work the lesson exercises at the end of this lesson before beginning the examination. These exercises will help you accomplish the lesson objectives.

LESSON 4

REMOVE AND REPLACE OR REPAIR DEFECTIVE COMPONENTS OF ANESTHESIA APPARATUS

4-1. GENERAL

Field repairs are usually limited to the replacement of worn or damaged parts. The following procedures for removing and replacing or repairing defective components of the Ohmeda field anesthesia apparatus are examples of the methods to use to correct common malfunctions. Once you have isolated a malfunctioning component, you should use your knowledge of the anesthesia process gained in Lesson 1 and the specific procedures discussed in this lesson to correct it. You must correct malfunctions before returning the anesthesia apparatus to service. For further information on removing and replacing or repairing malfunctioning components of the anesthesia apparatus, refer to the manufacturer's service literature or the manufacturer's service representative. This lesson covers the repair of the flow control valves; the replacement of the flow meter tube, scale, and float; and the replacement of the check valve disc.

WARNINGS

Never oil or grease any anesthesia oxygen equipment unless you use a lubricant made and approved for this type of service. In general, oils and greases oxidize readily and, in the presence of oxygen, they will burn violently. Vac Kote is the recommended oxygen service lubricant.

Never cover the anesthesia apparatus with any type of fabric or plastic covering. Removing the cover may cause static electricity and the possibility of a fire or explosion.

4-2. REPAIR FLOW CONTROL VALVES

If you have closed the cylinder valves during leak test number 2 and the flow meter still indicates a flow, you can isolate the malfunction to the flow control valve. You must repair the flow control valve. Refer to Figure 3-6, Control head - flow meters. Frequently, you can repair a leaking needle valve on the flow meter without replacing any parts. Use the following steps to attempt to correct the problem.

a. Loosen the two screws in the knob.

b. Remove the knob.

c. Tighten the packing nut.

d. Turn the stem clockwise until the leak stops.

e. Replace the knob.

f. Turn the knob clockwise until you reach its stop.

g. Tighten the set screws. Do not use excessive torque when closing the flow control valves. A stop indicates the closed position.

h. If the needle valve still leaks, refer to the manufacturer's service manual or the manufacturer's technical representative.

4-3. REPLACE FLOW METER TUBE, SCALE, AND FLOAT

If you have isolated the cause of a malfunction to the flow meter tube, you must replace it. The parts of the flow meter are not interchangeable. The flow meter tubes are imprinted with numbers which correspond to numbered positions that are on the flow meter top manifold. To replace a flow meter tube, do the following.

a. Match the number imprinted on the flow meter tube replacement with the broken flow tube.

b. Replace the flow meter tube, float, and scale. Replacing a float, scale, or flow meter tube alone destroys the accuracy of the flow meter.

4-4. REPLACE A WARPED CHECK VALVE DISC

If you have isolated a malfunction to a warped check valve disc during PMCS, you must replace it. A warped check valve disc could cause an inhalation or exhalation check valve to malfunction. Extra check valve discs are supplied with the apparatus. They are in the small vial stored in the lower case accessory compartment. Refer to figure 4-1. To replace a warped check valve disc, do the following.

a. Remove the knurled retainer ring, window, gasket, and the valve cage which holds the disc.

b. Remove the warped disc.

c. Replace the warped disc with the new disc, ensuring that the conical tip points up.

d. Reassemble the check valve.

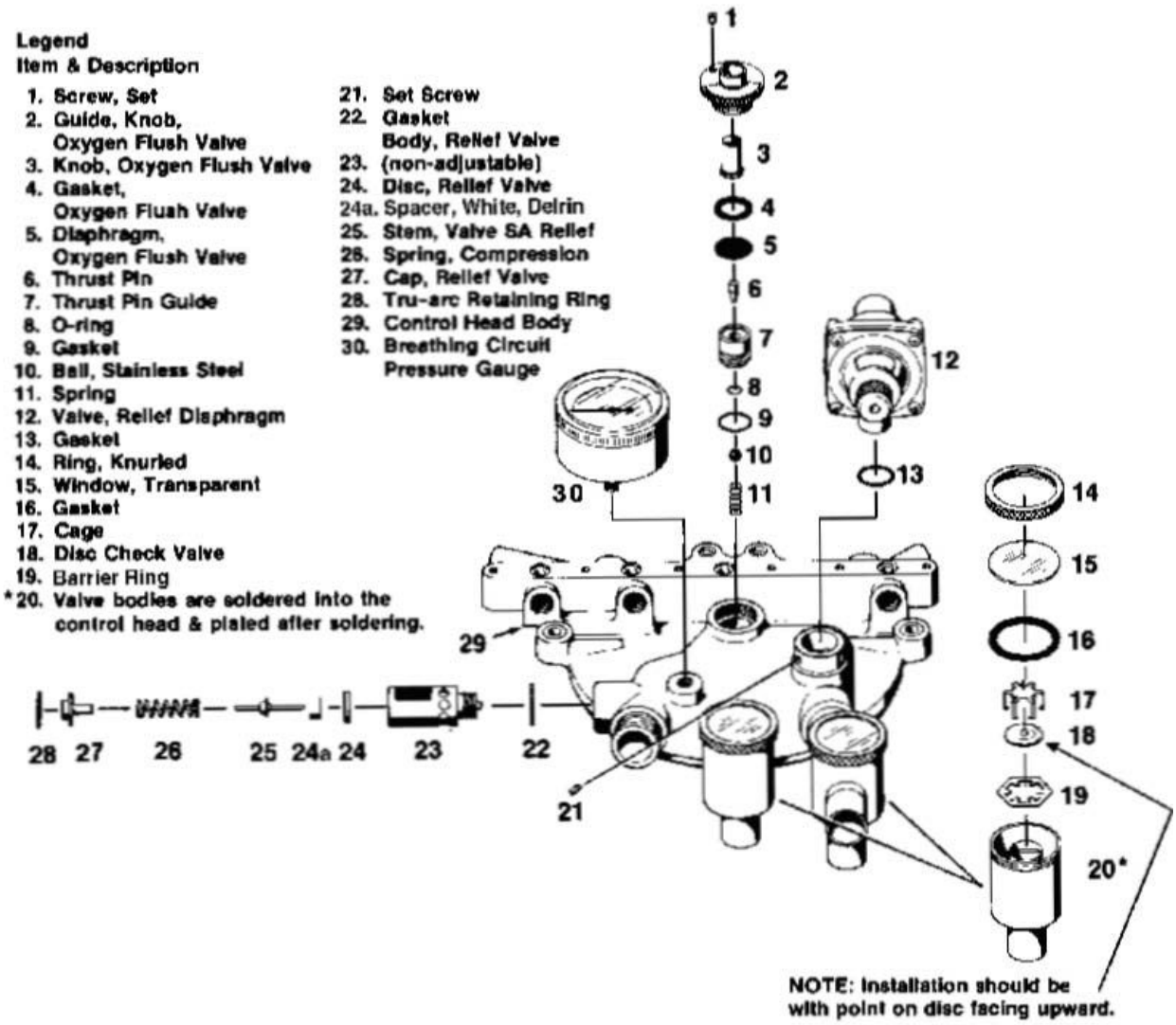


Figure 4-1. Control head-check valve disk

Continue with Exercises

EXERCISES: LESSON 4

INSTRUCTIONS: Answer the following exercises by circling the lettered response that best answers the question.

After you have answered all of the exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers. For each exercise answered incorrectly, reread the lesson material referenced after the solution.

1. Which of the following statements describes what you do to repair the flow control valve?

   a. Use a wrench or pliers to tighten the set screw very securely.

   b. Remove the knob, wiggle the sealing cap gasket and the stop float, and replace the knob.

   c. Turn the knurled flow control valve knob counter-clockwise to the stop, then turn clockwise until the leak stops.

   d. Remove the knob, tighten the packing nut, turn the stem clockwise until the leak stops, and replace the knob.

2. Which of the following statements about replacing the flow meter tubes is correct?

   a. You must match the color coding of the replacement flow meter tube with the broken flow tube.

   b. If you replace a flow meter tube alone, you destroy the accuracy of the flow meter.

   c. You can replace all flow meter parts easily because they are completely interchangeable.

   d. If you replace flow meter tubes, you must also replace the associated flow meter control valve.

3. What is the possible consequence of a warped check valve disc?

   a. The anesthetic vaporizer's valve could malfunction.

   b. The N_20/O_2 mixture will not be regulated.

   c. The corresponding inhalation/exhalation check valve could malfunction.

   d. The corresponding flow meter needle valve could malfunction.

4. To replace a warped check valve disc, which of the following procedures do you follow?

   a. Disassemble the check valve, remove the warped disc, and replace it with a new disc ensuring the conical tip points up.

   b. Disassemble the check valve, remove the warped disc, and replace with the new disc ensuring the conical tip points down.

   c. Disassemble the check valve. With two sets of pliers, realign the warped disc and replace it in the check valve.

   d. Disassemble the check valve, turn the warped disc over in the check valve, and reassemble.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES: LESSON 4

1. d (paras 4-2b, c. d)
2. b (para 4-3b)
3. c (para 4-4)
4. a (paras 4-4a, b, c, d)

End of Lesson 4